PETROLEUM PROCESSING

VOLUME 3, NUMBER 11 NOVEMBER, 1948

TECHNOLOGY DEPARTMENT

Research Tools as Modern As Their Housing

(p. 1047)

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FORMERLY MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS

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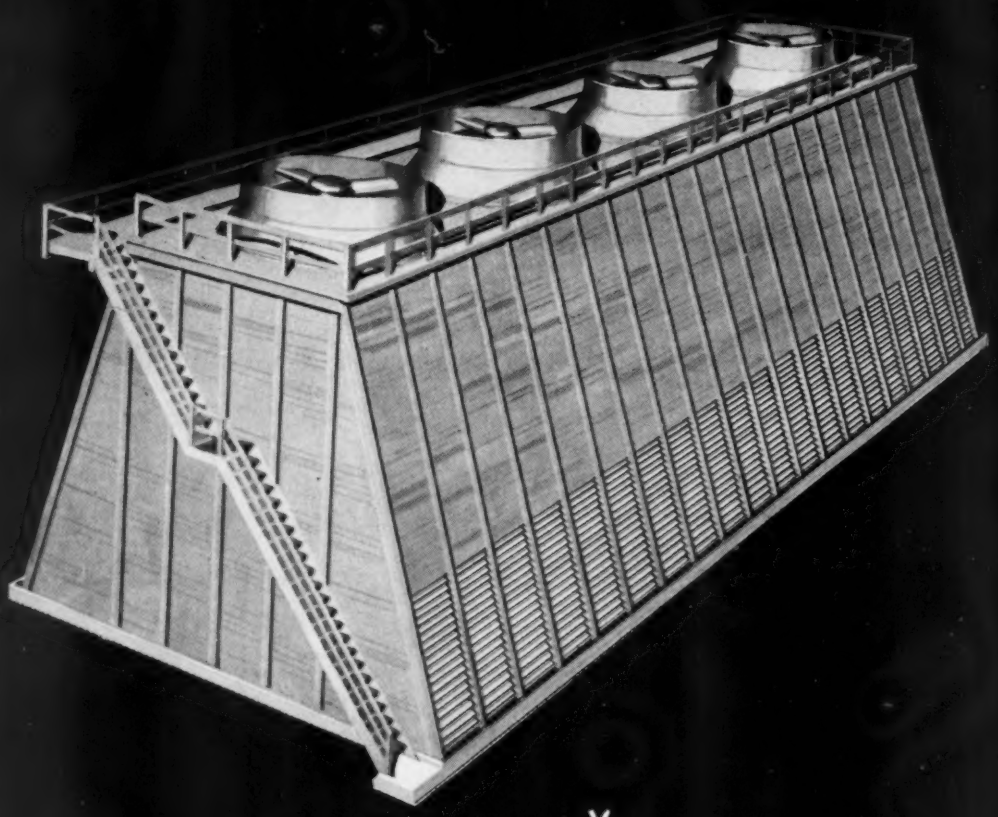

1 **IMPROVED AIR FLOW AND AIR-WATER CONTACT**

2 **ECONOMY IN FABRICATION AND ERECTION**

3 **LOWER OPERATING COST**

4 **GREATER STRUCTURAL STRENGTH**

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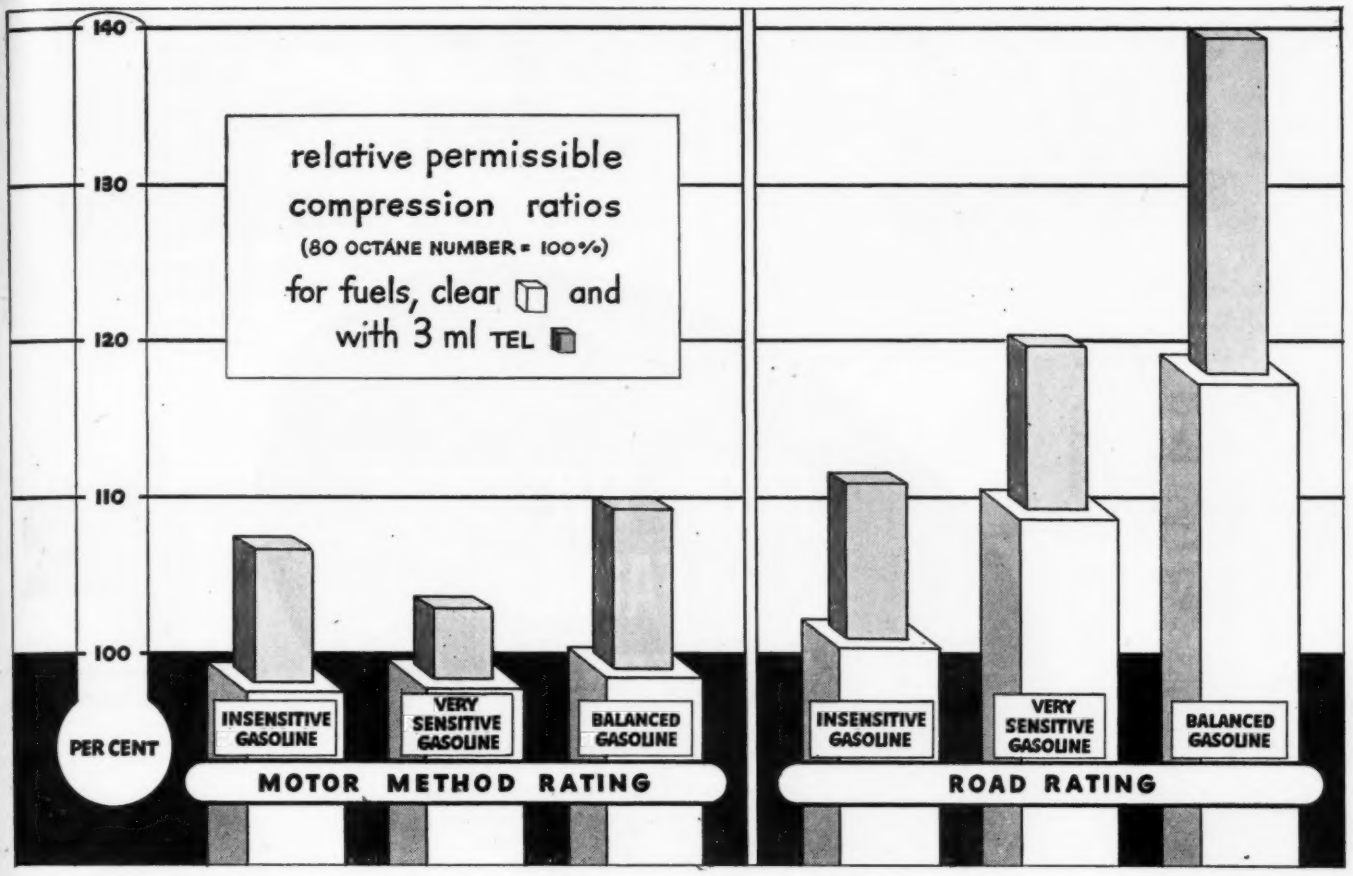

*Boosting "lead response" with balanced gasoline**

ETHYL research has shown that the hydrocarbon distribution over the boiling range of a gasoline has a big influence upon its road performance . . . the final criterion of any motor gasoline.

The charted study showing the gain in antiknock quality from the addition of 3 milliliters of tetraethyllead to base gasolines of three representative types—an insensitive, a very sensitive, and a balanced gasoline—tells a clear-cut story of balanced gasoline superiority. The vertical scale of the chart is proportional to the relative permissible compression ratio, with 100% corresponding to that allowable with a blend of standard reference fuels of 80 octane number.

Each of the three base fuels has a Motor method rating of approximately 80. When tetraethyllead is added to the insensitive gasoline, its antiknock quality is improved 8%. The very sensitive gasoline shows only half that improvement, whereas the balanced gasoline gives an improvement somewhat greater than that obtained with the insensitive gasoline.

Rated on the road, the insensitive gasoline yields a somewhat greater improvement than it did by the Motor method. In the very sensitive gasoline, the improvement is virtually the same as the improvement in the insensitive gasoline.

When the balanced gasoline is rated in cars on the road the benefits are spectacular. For now the improvement in antiknock quality resulting from tetraethyllead is more than double that obtained in the very sensitive gasoline. Furthermore, with tetraethyllead the balanced gasoline shows a much greater increase in road rating over Motor method rating than does the very sensitive gasoline. A comparison of the Motor method ratings of the unleaded base fuels with the road ratings of the leaded base fuels indicates that the balanced gasoline has a 93% greater improvement overall than the very sensitive gasoline.

The Ethyl Laboratories study the principles of "balancing" gasoline for optimum tetraethyllead effectiveness on the road as a service to refiners in their efforts to obtain the highest measure of performance from every drop of "Ethyl" antiknock compound.

**A balanced gasoline has a distribution of hydrocarbon types with respect to boiling range so controlled that it will give optimum road antiknock quality and improvement from the addition of tetraethyllead at all engine speeds.*

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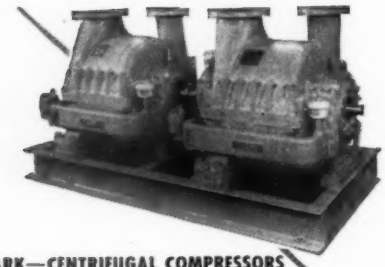
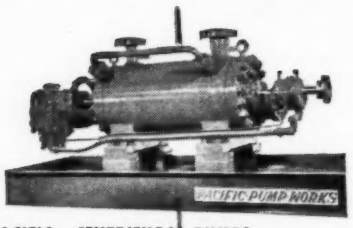
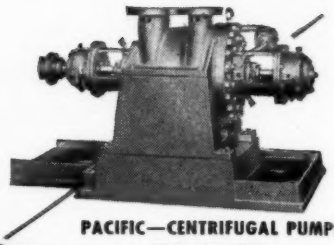


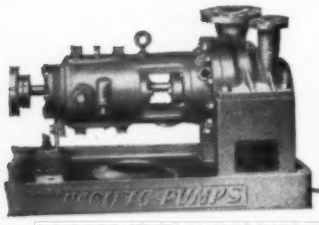
CLARK—CENTRIFUGAL COMPRESSORS



PACIFIC—CENTRIFUGAL PUMPS, MULTI-STAGE



PACIFIC—CENTRIFUGAL PUMPS, HOT OR COLD



PACIFIC—CENTRIFUGAL PUMPS, HOT LIQUID

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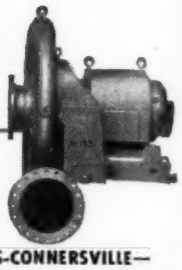

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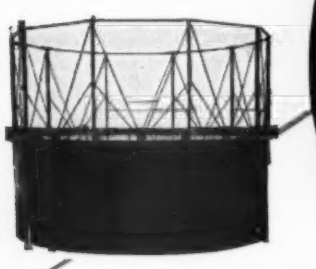

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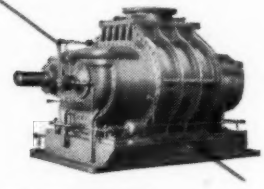

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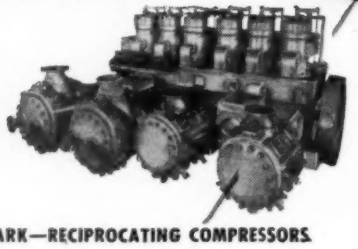

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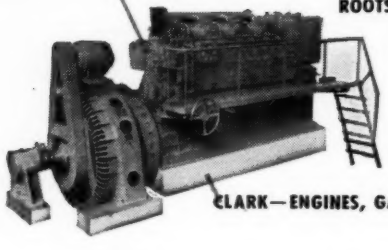

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PETROLEUM PROCESSING

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NATIONAL PETROLEUM NEWS
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OILGRAM PRICES
PLATTS'S OIL PRICE HANDBOOK

Covering the Management, Design, Operation, Equipment, Products of Plants Processing Crude Oil and Natural Gas into Fuels, Lubricants, Chemicals

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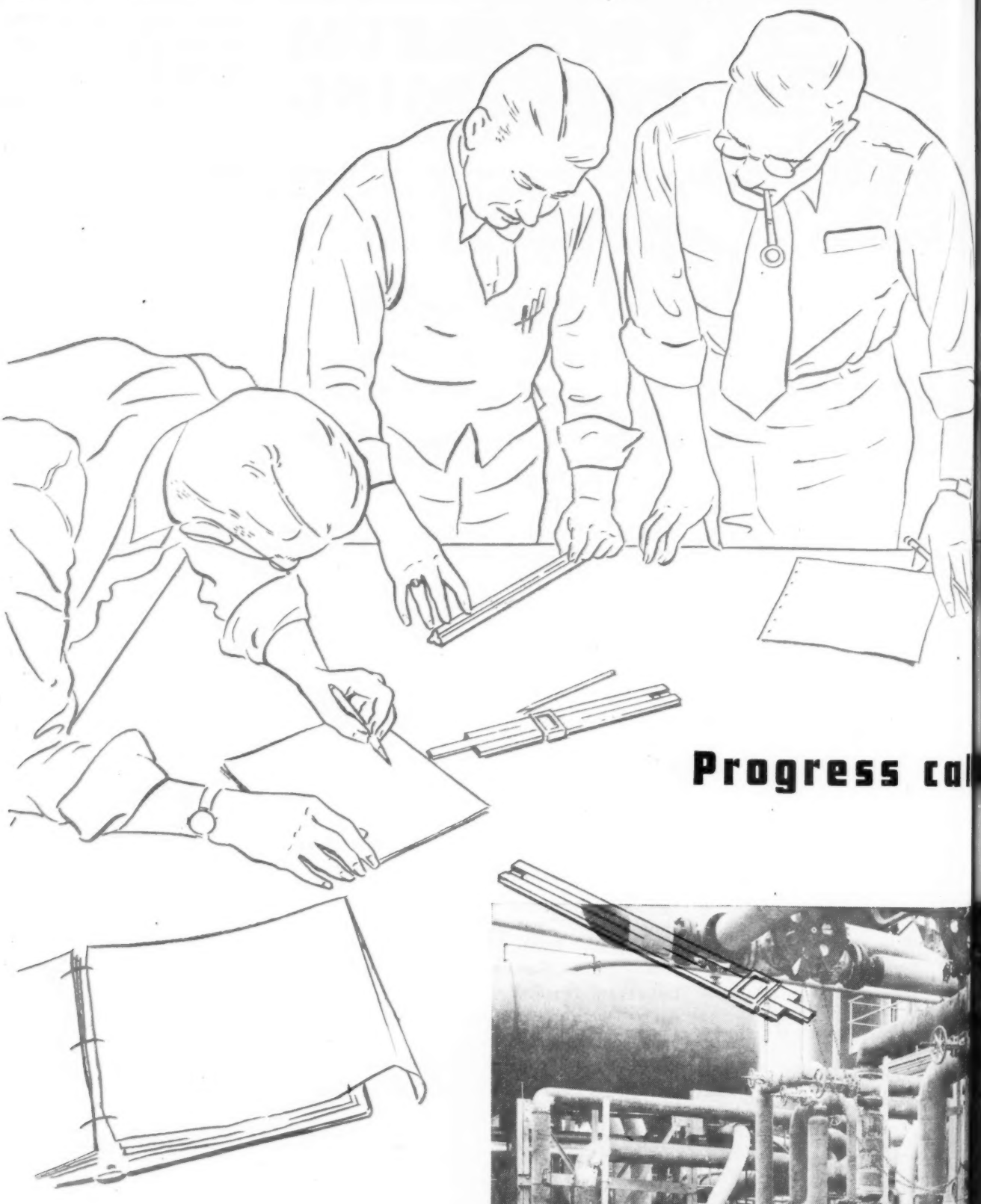

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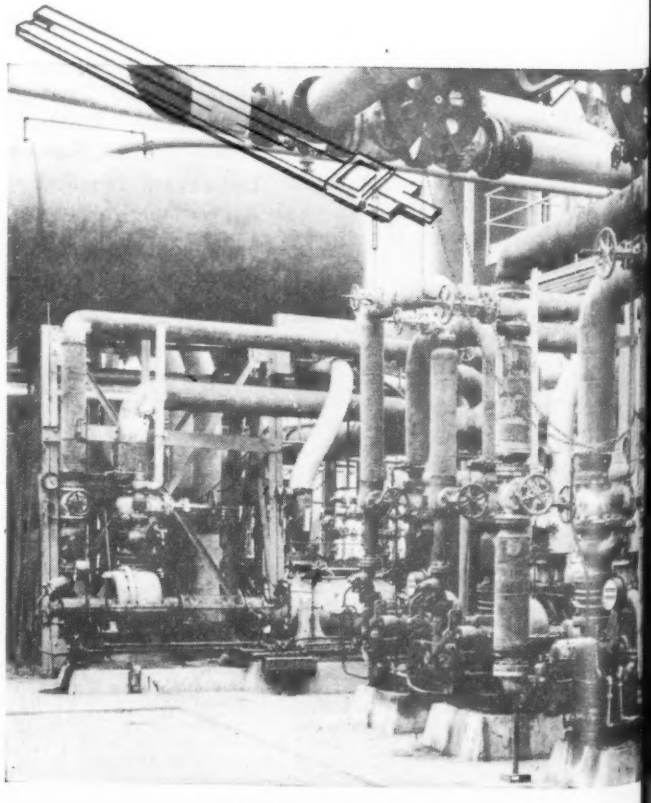

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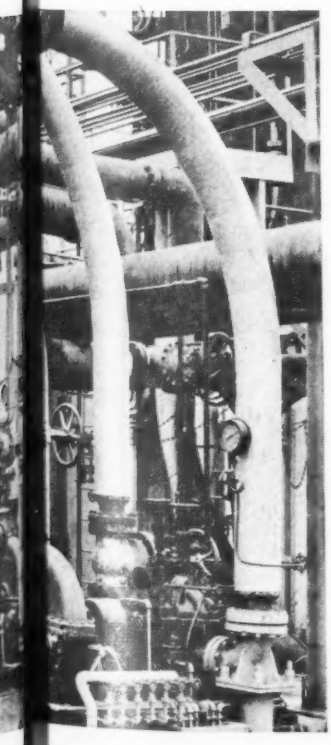

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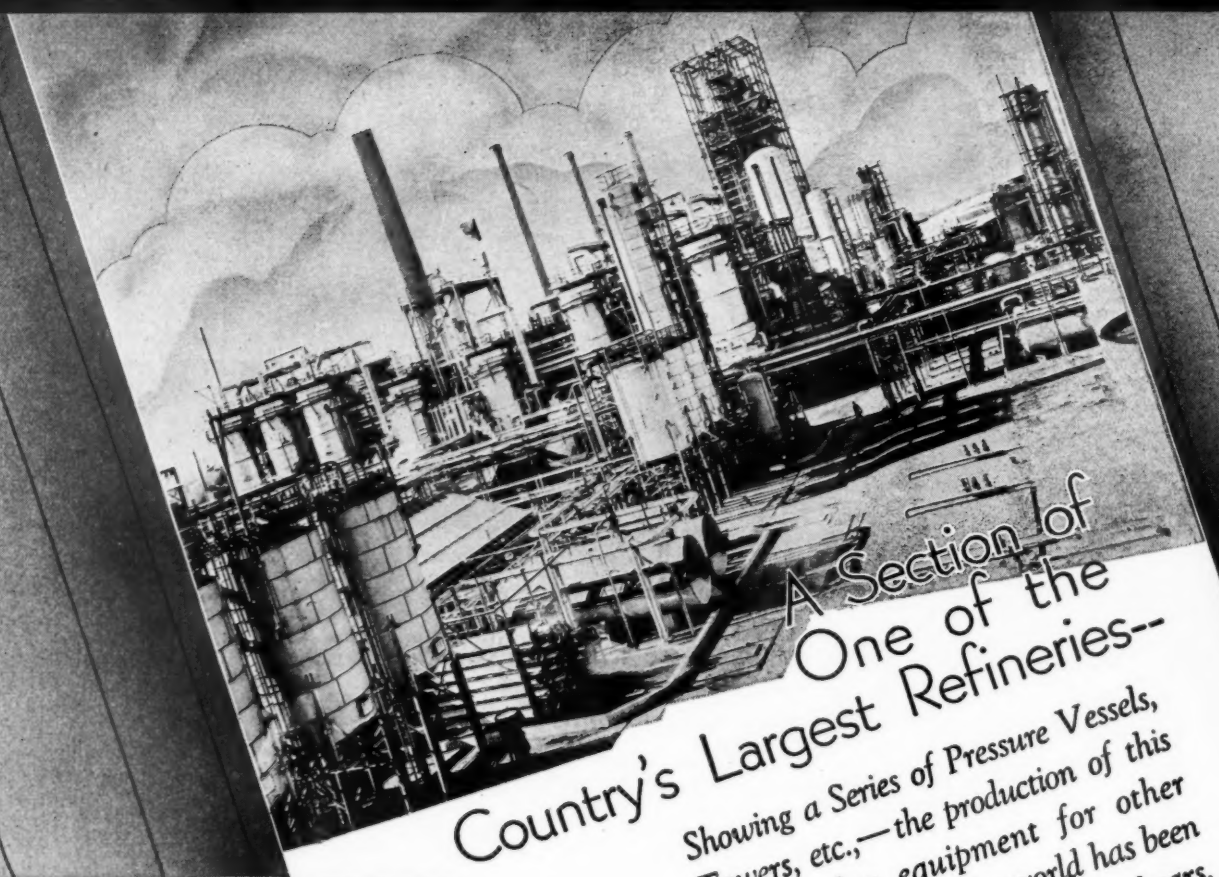

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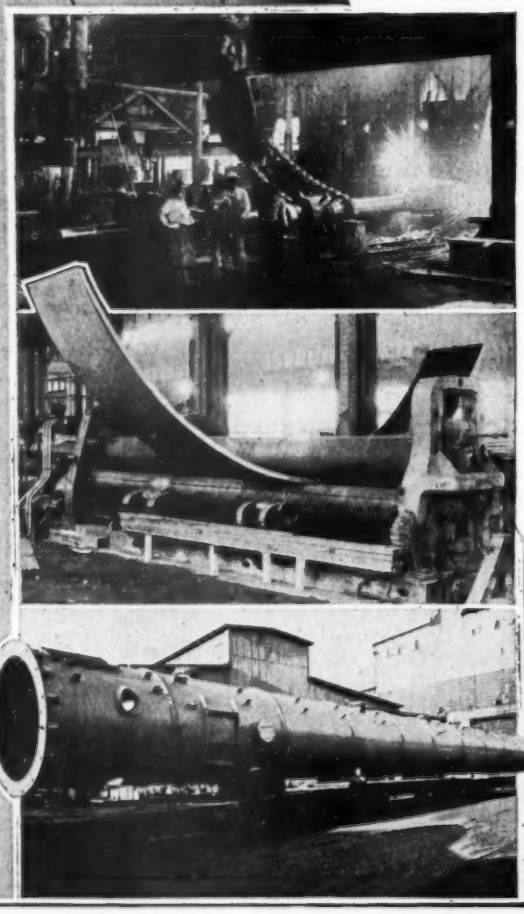

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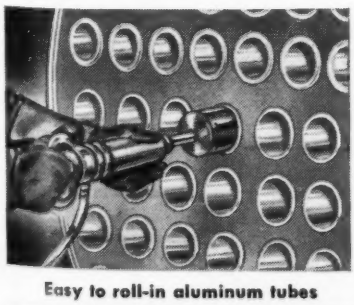

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What's Happening!

NOVEMBER 1
1948

Important Current News Summarized for Refiners

EXPANSION

Ohio Standard will begin construction within a year on a $13 million solvent refining lube oil plant at Lima. With a capacity of 76,000 gals./day, plant will more than double existing capacity at Sohio's Cleveland and Toledo refineries. Five units will provide vacuum distillation, solvent de-asphalting, solvent extraction, solvent de-waxing and clay treating. Cost is in addition to $16 million already planned for Lima expansion and is part of total $100 million capital investment program for 1948-50. Contract for de-asphalting unit has been let to Kellogg, and for other four units to Lummus.

Empire State Oil has let contract to Refinery Engineering, Inc., for combination 5,000 b/d topping, vacuum, vis-breaking unit at its Thermopolis, Wyo., installation. It will produce tractor distillate, burning, road, and fuel oils, and asphalt products from Hamilton Dome crudes.

Petco Corp. will install a Houdriflow unit at Blue Island, Ill., refinery. Unit will have charge capacity of 5,000 b/d. Houdry Process Co. is licensor and Clark's Construction & Engineering Co. is contractor.

Gilcrease Oil Co. placed in operation its recently acquired 4,000 b/d New Orleans refinery. Idle for five years, refinery will function as skimming plant.

Petrol Refining, Inc. has contracted with Rust Engineering, Inc. to design and erect two crude oil topping units with combined capacity of 50,000 b/d for Texas City plant. Present combined capacity of company's Texas City and Beaumont plants is about 30,000 b/d.

Tide Water Associated's refinery at Drumright, Okla., is being expanded by addition of a 6,700 b/d Houdriflow catalytic cracking unit by Houdry Process Co., with completion scheduled for late 1949 or early 1950. Present capacity at Drumright is 18 to 20,000 b/d.

• • •

NATURAL GASOLINE

Capacity of natural gasoline industry in U. S. to produce light hydrocarbons increased during two-year period Jan. 1, 1946 to Jan. 1, 1948 from 426,860 b/d to 507,670 b/d, according to a recent Bureau of Mines survey. During same period, and despite increase in capacity, total number of all types of natural gasoline plants declined from 626 to 549.

Copies of report may be obtained without charge by writing Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa. Ask for Information Circular 7488, "Natural Gasoline and Cycle Plants in the U. S., Jan. 1, 1948."

Humble Oil & Refining will start construction soon on $2,800,000 absorption type gasoline plant at Opelousas, La. Hudson Engineering Corp. will handle the job.

• • •

LABOR

West Coast strike of Oil Workers International Union (CIO) against six major refining and two producing companies entered its ninth week Nov. 1, with both sides expressing hope of an early settlement. Strike was precipitated Sept. 4 by collapse of efforts to reach agreement on wage increase. OWIU demanded 21c an hour, 9c under original demand; companies countered with offer of 12.5c an hour, retroactive to July 3.

After weeks of negotiations, OWIU leaders expressed willingness to accept the 12.5c offer, but by then rehiring issue had displaced wage issue and a new deadlock appeared. In addition, still factors in negotiations were questions of reinstatement, letting of contracts to outside firms for maintenance work, security rights of workers, and method of returning employees to work.

Meanwhile, all companies reported their refineries back on stream and running at near-normal capacity, operating with supervisory personnel, workers who hadn't struck, and strikers who returned to work. API. statistics for week ended Oct. 23 showed throughput at 863,000 b/d (79.0% of rated capacity), compared with 862,000 b/d for week ended Sept. 4, last prestrike period reported.

But even though throughput was "near-normal" output wasn't. Production of residual fuels was up over 25% above prestrike figures, mainly at expense of gasoline, with bulk of latter product being regular grade rather than premium.

Elsewhere in California labor picture, the Independent Union of Petroleum Workers signed an agreement with California Standard calling for a 12.5c hourly increase, retroactive to July 8 and covering about 3000 workers. Similar agreements previously

Information on these pages is obtained through the nation-wide news coverage services of PLATT'S OILGRAM NEWS

had been reached with Texaco and Union Oil. The independent union was not on strike.

Strike against Ohio Standard was settled at Cleveland refinery Sept. 30, and at Toledo plant Oct. 12, when respective OWIU locals signed two-year contracts calling for a net wage increase of 11.5c an hour over prestrike pay.

• • •

PRODUCTS

Iso-octyl alcohol is now being made commercially from petroleum at Esso Standard's Baton Rouge refinery by an adaptation of the so-called O.X.O. process the Germans developed during the war to produce alcohols from olefins from the Fischer-Tropsch process. The product is used, in combination with phthalic anhydride, as a plasticizer for resins used for making artificial leather and other fabrics. The basic technique developed for making iso-octyl alcohol may have extensive application in making chemicals required in the manufacture of synthetic fibers, resins, detergents and other materials.

A new motor oil aimed at reducing engine-wearing acid action of partially burned fuel gases and moisture is now being marketed by Shell Oil Co. Such action, Shell claims, accounts for 90% of engine wear. New oil consists of a high grade base stock plus a new additive containing detergent, anti-oxidant and anti-wear agents.

• • •

PRICES

Advance in crude oil prices of 35c per bbl. posted by Phillips Petroleum Co. late in September kept markets for refined products unsettled throughout the past month. Five Independents met the Phillips' increase; major crude buyers put up a solid front against the move toward higher prices. One of the Independents, Southern Minerals Corp., rescinded its action late in October.

Phillips' president K. S. Adams declared higher prices are needed to "furnish the funds required to cover presently inflated costs of finding, drilling and producing additional crude oil reserves." Consensus of the flood of ensuing statements by major buyers was that present supply was sufficient to meet foreseeable demand; that higher prices were not needed to stimulate production.

The crude controversy slowed trading in refined products markets temporarily. But there then followed a flood of selling in many districts due mainly to the high level of products inventories. The Gulf cargo market was more active than at any time during the past three years. Ten cargoes of No. 2 fuel, last winter's shortest item, changed hands.

Top-heavy inventories also depressed prices for other products. Pennsylvania bright stock was off 6c to 30c per gal.; Midcontinent bright stock down 2c to 31c. Heavy fuels were priced 5 to 40c per bbl. lower throughout the Midcontinent, with Oklahoma No. 6 off 5c to new postwar low of $1.75 per bbl.

Lead prices took another jump Nov. 1, the fourth of the year, going to 21.5c a pound, an increase of 2c over the 19.5c level reached July 28. Although no announcement has yet been made by either Ethyl Corp. or DuPont, previous two price increases for lead this year were followed by increases in the price of tetraethyl lead at later dates.

• • •

PETROCHEMICALS

Lion Oil will begin construction this month of a sulfuric acid and an ammonium sulfate plant estimated as a $2,000,000 project, at its El Dorado, Ark., chemical plant. Acid unit will be "contact" type and produce 300 tons/day from 100 tons of Texas bright sulfur or equivalent. Sulfate production is to be 380 tons/day of commercial grade from 288 tons daily of sulfuric acid and 100 tons ammonia.

Indiana Standard has formed wholly-owned subsidiary, the Indoil Chemical Co., to handle chemical activities. Officers include W. B. Plummer, president and Dr. R. C. Gunness, vice-president. Two new products to be added to present line are alkanesulfonic acid and nonyl alcohol.

Phillips Chemical Co. has purchased Todd Ship Yard property on Houston ship channel for construction of a 266,000 ton/year ammonium sulfate plant, with total production to be reached early in 1949. Name of location has been changed to Port Adams, for company president K. S. Adams.

• • •

RESEARCH

Demonstration of the impetus the oil companies are giving to research and development work on petroleum processes and products in the postwar period is supplied by the formal opening of two new laboratories; that of Standard Oil Development Co. at Linden, N. J., Oct. 14, and that of Sinclair Refining Co. at Harvey, Ill., Oct. 22. The former is the first unit at the proposed Esso Research Center of complete facilities for SOD, and the latter is the complete research and development laboratory of Sinclair, part of this company's post-war expansion program.

Both institutions provide modern equipment and facilities for a wide field of research in the manufacture and utilization of petroleum products. Greatly augmented research staffs are made possible for both companies through their new facilities.

Conservation is today's watch-word. It emphasizes the vital importance of building refinery units to make the most from available crudes with the least expenditure of steel.

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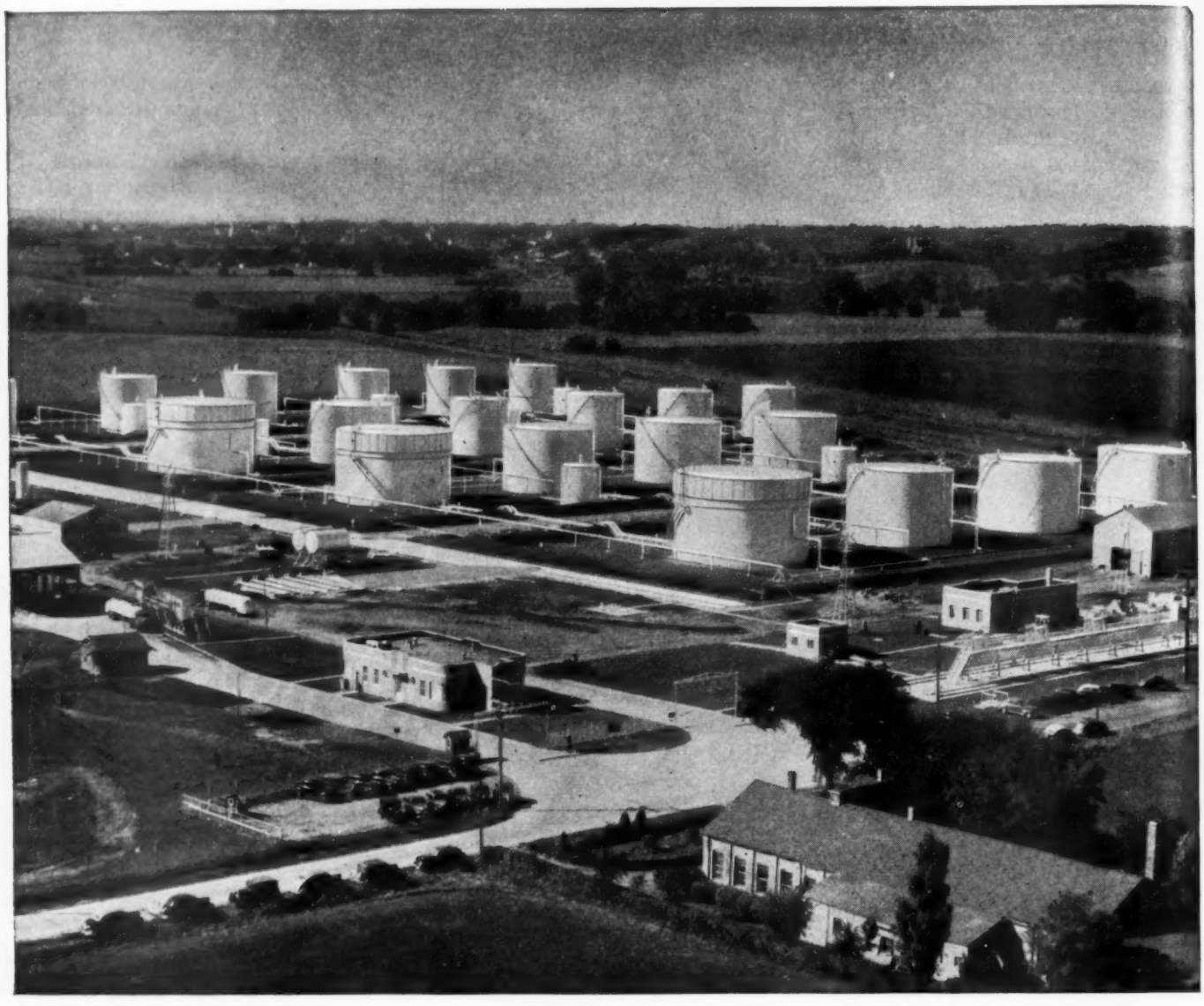

LONG SHOT OF A SURE THING

This pipeline terminal is a sure thing when conservation of petroleum vapors is considered. Manifold lines connect three Expansion Roof tanks to the twenty-two cone roof tanks to give this terminal extra capacity to take care of the expansion of vapors due to rises in temperature or the displacement of vapors due to pumping in operations.

The manifold lines and tanks form a closed system, which holds the vapors under normal terminal operation . . . the daytime expansion of vapors being offset by pumping out and the night filling being offset by shrinking due to lower temperatures. Vapor pressures alone cause the Expansion Roofs to rise or descend.

Venting to the atmosphere and the intake of moisture-laden air are prevented . . . all standing losses and most filling losses are eliminated.

For the details on a sure thing for your petroleum storage facilities, write for the latest bulletin on the Expansion Roof.

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GRAVER TANK & MFG. CO., INC.

East Chicago, Indiana

Graver offers a complete service to the petroleum industry including Expansion Roof Tanks, Floating Roof Tanks and pressure vessels. In addition, Graver is prepared to furnish specialized steel plate work such as fractionating columns and clad one vessels as well as stainless and alloy fabrication; water conditioning equipment of all types; and through the Graver Construction Co., is prepared to handle all types of petroleum and chemical construction work.

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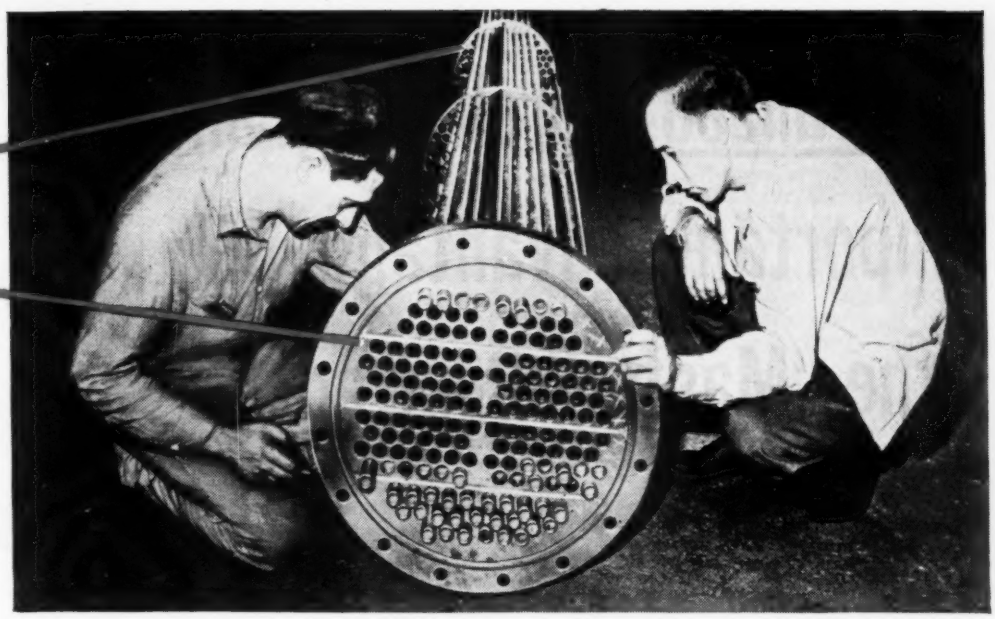
STAINLESS TUBING IS BEST

WHERE CORROSIVE ATTACKS ARE WORST



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No tubing material can withstand so many corrosive conditions so effectively as stainless steel. It is corrosion's arch enemy. Its chemical resistance makes it impervious to the action of petroleum products and many other media, hot or cold. It lasts indefinitely in many services because it is stainless from inside to outside.

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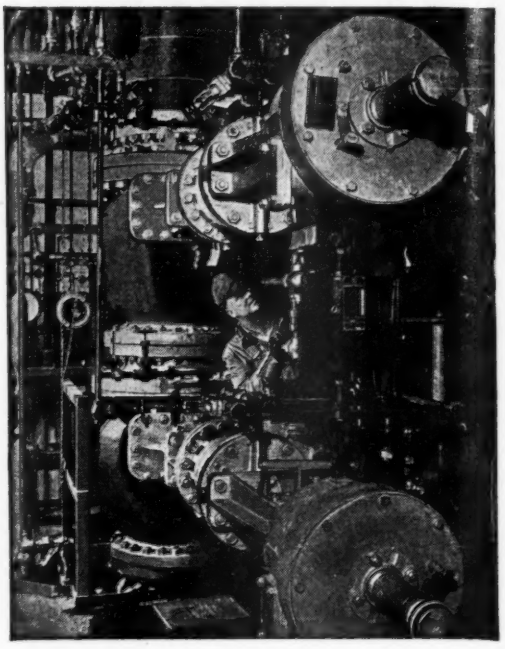
PLANTS: BEAVER FALLS, PA. AND ALLIANCE, OHIO.

NUMBER 4 IN A SERIES



Centralized Purchasing an important advantage of the "Master" Contract!

IN times of normal supply, the advantages gained price-wise and service-wise in the bulking of orders through centralized purchasing is, of course, a known reality to all purchasers. But perhaps many have not realized that in a market of scarcity, which most certainly exists today in the industries that supply materials and equipment for refinery installations, *centralized* purchasing has many other advantages that are much more important.

When a refinery modernization job is split among several contractors, who must of necessity purchase approximately the same types of equipment and materials in competition with each other, a refiner in effect sets up competition for himself. It is obviously impractical, or prohibitively costly, for a refiner to establish a special coordinating group of his own to schedule and allocate the available materials and equipment among several contractors. Consequently if pumps are successfully expedited by one contractor, most likely another contractor working at the same site must wait. With the well-known perversity of inanimate objects, it is usually the contractor whose job should be completed first who is the one to wait—thus the on-stream day of the overall job is postponed unnecessarily and the earning power of the refiner reduced, because a day's production lost in the refinery business is lost forever.

Under the *"Master"* contract however, where all work on *one refinery site* is undertaken by the *same* contractor, purchases of scarce material are keyed to an overall progress plan—the first pumps needed are the ones that the manufacturers are pressed for, the ones not needed until later are ordered for a later date, thus fitting purchases more readily into manufacturers' production schedules and securing closer cooperation.

Many materials are in the same scarce condition as equipment. As everyone knows steel is being allotted voluntarily—no refiner getting much more than his proper share. However, through *centralized* purchasing, steel purchases can also be coordinated with the overall progress plan and the ceaseless competition for tonnage between rival contractors, serving the same refiner, can be eliminated.

E. H. HANHAUSEN

Director of Purchases

The M. W. Kellogg Company

Important as this one factor is—and it can mean weeks and sometimes months of added earning power to a refiner—*centralized* purchasing has many other advantages.

Elimination of competition for local sub-contractors' facilities and manpower; reduction of time charged to the overall contract through elimination of duplicate inspectors and expediters in the same vendor's plant; removal of much of the invoice checking and price comparison from the refiner's hands and consequent reduction in the amount of accounting time necessary, are but a few.

Thus even in a more or less prosaic phase of the work of the engineer-contractor, the "master" contract shows important advantages similar to those disclosed previously in the engineering phases. And when expenses really start to bulk in the field, the "master" contract shows immediate dollar savings which, when applied to the magnitude of daily expense required in today's refinery modernization work, are worthy in themselves of serious consideration by every refiner. The next advertisement in this series will discuss the advantages of the "master" contract in field construction work.

Our company—M. W. Kellogg—is completely staffed and equipped for refinery and chemical plant design and construction, from the step of laboratory research through the initial operation of completed plants. It periodically issues a publication called the KELLOGGRAM, which describes many of these services. If you are not already receiving it, we will be glad to add your name to the list if you will drop us a line at 225 Broadway, New York 7, N. Y.

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TOMORROW

. . . IN PETROLEUM TECHNOLOGY

Current technological and economic developments discussed here in the light of their future bearing on petroleum refining operations include:

- **Improvements in fluid catalytic cracking in 6 years.**
- **Use of Diesel locomotives will continue to grow.**
- **Contract for surplus refinery gas is renewed.**
- **Will new uses develop from glycerine synthesis?**
- **High compression without higher octane fuels.**
- **New synthetic fibers continue to be introduced.**

Improvements in Fluid Catalytic Cracking Listed

ONLY SIX YEARS have passed since the first fluid catalytic cracking plant went on stream at Baton Rouge, La., but this period has witnessed a long series of gradual changes which have greatly improved what was initially a technically sound process. Even those closely associated with plants using this process, however, have probably failed to realize just how many changes have actually been made, as is presented in a recent issue of *The Kelloggram*(1). Fluid catalytic cracking units are now operating at record throughputs, employing milder operating conditions than were used during the war. Recycling is employed, to increase the yields of middle distillates, and cracking capacity has been increased by conditioning the reduced crude charge in special units, such as propane decarbonizing plants. Preheat furnaces permit greater throughput, and overall height has been reduced through better knowledge of capacity design. A "balanced pressure" design on new units has changed the contour of recent plants.

New catalysts are being tested, and refiners now have a better understanding of catalyst mechanics. Four improvements in catalyst handling may be noted. On recent units, the slurry settler is now in the base of the fractionator, and the electrical precipitator is now of cylindrical shape. The cyclone separators have been improved, and a new refractory lining developed for the regenerator.

Progress has been made in noise abatement, fewer instruments are now required, double slide valves prevent unscheduled shutdowns, and a new pipe bending process improves large catalyst carrier lines. Kellogg has completed 28 fluid catalytic cracking plants and is building 14 more; the total capacity of these plants is "more than 750,000 b/d of feed, in units ranging from 4,000 to 40,000 b/d capacity. Today, Kellogg cat-crackers account for more than 70% of the world's fluid catalytic-cracking capacity now in operation," not counting the 14 plants under construction.

(1) Anon., "Six Years of Fluid Cat-Cracking Produce Many Changes," *The Kelloggram* 1948, No. 5.

Diesels Shown Efficient Consumers of Petroleum

THE "WHITE PAPER" recently issued by the General Motors Corp. on the subject of oil use by Diesel locomotives does a good job of "putting the blast" on charges that railroad Diesels are "(1) Depriving householders and other fuel oil consumers of needed oil; (2) Placing a heavy burden on the nation's refining capacity; (3) Speeding up the drain on our dwindling oil reserves.(2)

As General Motors points out, railroad Diesels used only 52,000 b/d of the 317,000 b/d of oil consumed by the railroads in 1947, the remaining 265,000 b/d being heavy fuel oil consumed by heavy-oil-burning steam locomotives. Moreover, the claim is made that even if *all* coal- and oil-burning steam locomotives were replaced with Diesels, total Diesel fuel consumption by the railroads (at 1947 operational levels) would be only 256,000 b/d, showing conclusively "that Diesel-electrics are far more efficient users of oil than oil-burning steam locomotives."(2)

The statement is made that present Diesel-electric locomotives consume only 1% of total U. S. oil use; that their oil consumption rose only 44,900 b/d from 1941 to 1947, during which period oil demands from other users rose 986,000 b/d; that scrapping all Diesel-electric locomotives would extend oil reserves only 45 days, while 100% Dieselization of the railroads would deplete oil reserves only seven months earlier. Finally, it is said that "complete Dieselization of the railroads would, on the basis of 1947 figures, save the railroads $340,000,000 a year on their fuel bills, $210,000,000 annually on maintenance and repair costs.(2)

The trend toward increased railroad use of Diesels is unmistakable. This trend will not result in larger net sales of "oil" for the petroleum industry, but it will bring about increased demand for a higher quality (hence higher priced) product. It will also bring with it complications resulting from the necessity of producing more Diesel oils instead of other products.

(2) Anon., "How Much Oil for Diesels?" *Business Week*, No. 996, 23 (1948).

Renew 15-Year Contract For Surplus Refinery Gas

ONE OF THE FIRST large-scale endeavors in the manufacture of chemicals from petroleum resulted, in 1935, from a 15-year contract the Standard Oil Co. (Indiana) made to supply refinery gases from its Whiting refinery to a chemical plant built on an adjacent site by the Carbide and Carbon Chemicals Corp. Since then, an increasing proportion of Standard's refinery gas output, previously burned as fuel, has been consumed by Carbide in the production of acetone, acetic anhydride, alcohols, etc. Hence, from one point of view, it is not at all surprising to note that Standard and Carbide have drawn up a new 15-year contract, to run until 1965, under which Standard will supply a substantially greater volume of gas (valued at approximately $75,000,000 for the 15-year period).

The petroleum industry, by now, has come to realize that at least some constituents of its refinery gases have values far in extent of their thermal worth. Rising fuel prices have not altered this situation to any great extent. What many refiners have realized only too well, however, is the fact that their daily output of these "precious" gases is far in excess of the amounts which can be converted into one or a few chemicals without glutting the markets for the products.

The raw material situation is different for the chemical company which produces petrochemicals. Its only concern is an ample supply of gases (and other petroleum fractions) of reasonable uniformity at reasonably level prices. For this reason, the early and obvious answer to the refiner's dilemma, where he could find a customer, was to sell his gases to a chemical producer, thereby receiving more money than the fuel value of the gases without entering a new and competitive field.

Since these early days, more and more petroleum companies have de-

cided to produce at least a few chemical products for themselves, or at least to engage in considerable research leading to such production. Among this group is the Standard Oil Co. (Indiana).

The petrochemical enthusiast may wonder, then, why Indiana Standard chooses to renew a long-term commitment to sell its refinery gases to some other company for use in chemical manufacture. The answer undoubtedly lies in the previously mentioned fact that every large refiner, especially those with several refineries, produces more potential chemical raw materials than he can conceivably use, and, even if he is himself engaged in manufacturing certain chemicals, it is only good business to sell his surplus at a profit when a ready market exists.

Petrochemical production by petroleum companies will certainly continue to increase—perhaps rapidly—but chemical companies will also continue to play a leading role in a field which they largely pioneered.

Will New Uses Develop From Glycerine Synthesis?

THE RECENT PLACING ON-STREAM of Shell Chemical Corp.'s new synthetic glycerine plant at Houston has received far too much publicity to warrant detailed description here, but the intriguing aspects of this synthesis certainly merit some consideration.

First of all, why did Shell hesitate eight years before putting a pilot-plant process into commercial use? To this a simple answer is available; glycerine sold for 12c per lb. in 1940; now sells for 40c. Moreover, while prices have fluctuated widely in the past, due to temporary under- or over-supplies, production (as a by-product from soap manufacture) increased only 20% from 1941 to 1947, while the output of many materials which employ glycerine has skyrocketed many times this figure. As a result, demand has been heavy and prices have been profitable to the producer.

Nor is there any reason to believe that prices will soon decrease. Sales of detergents have cut heavily into demands for soap, and lower soap production means lower by-product glycerine production. Moreover, lower prices for glycerine (Shell's production will stabilize the market, perhaps at somewhat lower levels) may force still higher prices for soap and thus further disturb the market balance between soap and the synthetic detergents.

Shell is said to believe that stable prices for glycerine may invite the development of new, large-scale uses. Other methods of synthesis exist, such as hydrogenolysis of sugars, but none appear to offer competitive possibilities at present, with the possible exception of a method patented by du Pont (reaction of formaldehyde, methanol, and carbon monoxide, followed by alcoholysis of the glycolic acid ester and reaction with hydrogen).

The output of Shell's plant has not been disclosed but one source[3] places it about 20,000,000-25,000,000 lbs./year and this same source believes that Shell can produce it to sell profitably for about 25c per lb.

Uses for glycerine are said to total over 1500, and new ones are certain to appear. If prices are "right" and technical progress is maintained in the production of synthetic fatty acids from petroleum or Synthine waxes, the day may even come (as it did in Germany, during the war) when edible oils may be reconstituted from glycerine and fatty acids produced from petroleum. Under any circumstances, there is no doubt that Shell's entry into the glycerine synthesis field will have many industrial repercussions. Glycerine has joined the ranks of important chemicals from petroleum.

High Compression Without Higher Octane Fuels

R. J. S. PIGOTT, Chief Engineer of the Gulf Research & Development Co. and president of the Society of Automotive Engineers, has long been known in petroleum and automotive circles for his incisive (and sometimes biting) remarks on current practices in automotive engines, gasoline octane numbers, lubricants, and economy vs. power.

As a good engineer, he is sometimes impatient with practices said to be desired by the public, and with the public's tendency to shout for economy and to demand power and weight at the same time, but those who hear or read his addresses are left with a much clearer understanding of the fundamentals involved.

Typical of his addresses was a recent resume[4] of trends in the compression ratios of future automobiles and ways to avoid the need for excessively high octane gasolines to power the latter. Unlike those men in the petroleum industry who are "fighting" higher compression ratios because they have a (well warranted) fear that no adequate quantity of high octane fuels could be produced for them, Pigott accepts the fact that an increase in compression ratio is inevitable, and concentrates upon the fact that "there are several ways in which the need for higher octane gasoline can be avoided." His remarks on "the dual fuel idea," an extension of "the turbo-supercharger idea," "controlled swirl" fuel injection, etc., should be read in full by those who would like to know what can be done to maintain a logical balance between petroleum industry fuels and automotive industry engines.

New Synthetic Fibers Continue to Appear

THE PETROLEUM INDUSTRY'S interest in synthetic fibers is almost entirely associated with the synthesis of petrochemicals for use as their basic materials, but it is definitely an active one, especially in those companies engaged in petrochemical production.

Recently, therefore, the industry was interested to note the release[5] of technical information on Vinyon N fibers, which are "based upon a copolymer of vinyl chloride and acrylonitrile," both of these chemicals being derivable from petroleum (ethylene) and actually so synthesized to some extent. Vinyon fibers of the vinyl chloride-vinyl acetate copolymer type have been on the market for almost ten years and have many uses, but the new Vinyon N fibers have properties which exceed those of the earlier product in many ways. Because of higher melting points, they "can now be exploited in upholstery and drapery fabrics and in clothing. Their controlled shrinkage characteristics make possible new inexpensive processes for the manufacture of familiar seersuckers and crepes." In addition, the new fibers are more resistant to solvents.

Carbide and Carbon, the manufacturers of the Vinyon fibers, are obviously seeking for fibers which will compete more satisfactorily with du Pont's' nylon, but it is evident, from a recent announcement[6], that du Pont is not taking this technological competition lying down. Its new fiber, "Orlon", is expected by du Pont to fill a price and property gap which exists between nylon and rayon. No information is at hand on the chemical nature of Orlon, other than the statement that its "base is natural gas or petroleum, or both," and production is said to be still in the pilot-plant stage, but "the eventual price is expected to be somewhat closer to rayon than nylon," and it is possible that Orlon, too, may be derived from vinyl and acrylic compounds. Du Pont, it is said, may build an Orlon plant at Camden, S. C., to come into production in about two years.

(3) Anon., "Glycerine from Gas," *Chemical Industries* 63, No. 3, 374,375 (1948).

(4) Anon., "Higher Compression Automobile Engines in '49 Seen as Probability by Pigott, Head of SAE," *National Petroleum News* 40, No. 38, 21 (1948).

(5) Rugeley, E. W.; Field, T. A., Jr.; and Fremon, G. H., "Vinyon N Resin and Fibers," *Industrial and Engineering Chemistry* 40, No. 9, 1724 (1948).

(6) Anon., "Nylon's Brother," *Business Week*, No. 991, 20 (1948).

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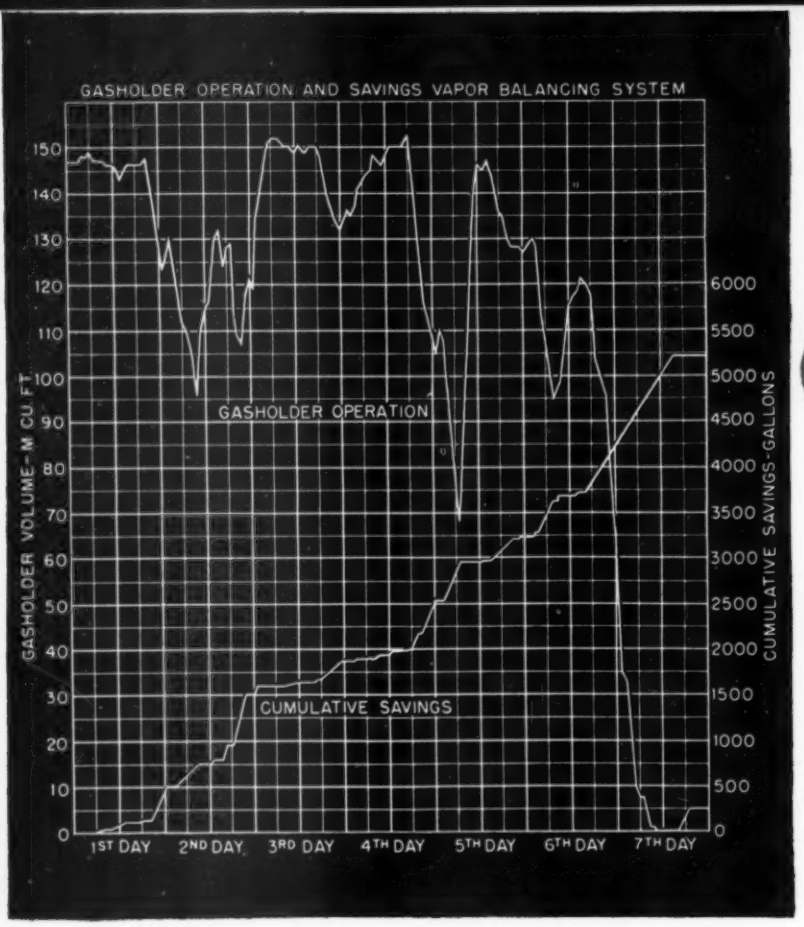

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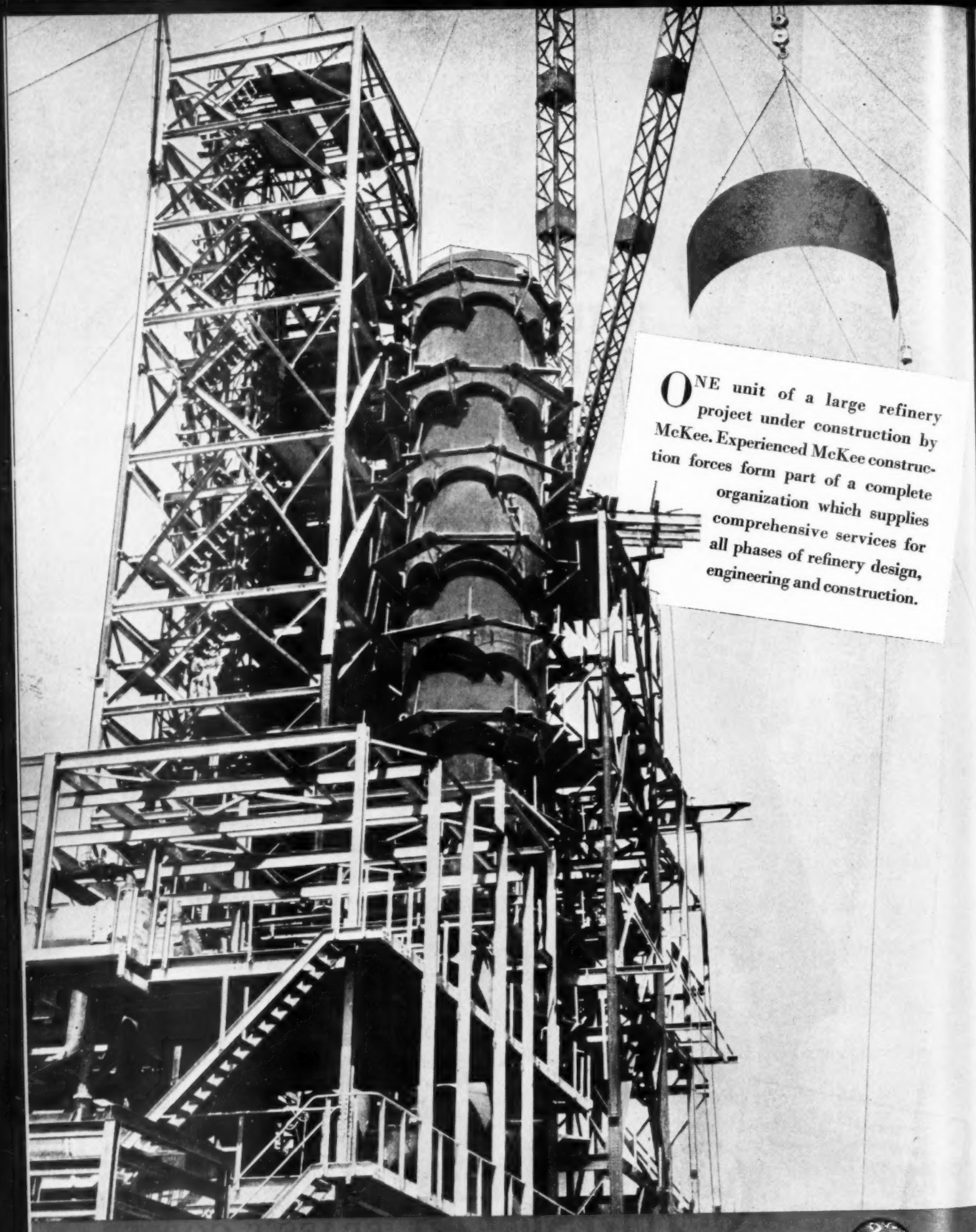

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NOVEMBER, 1948

Oil Measurement Procedure Is Being Standardized World-Wide

Staff Report from New York

METHODS FOR THE MEASUREMENT of oil in tanks are being standardized on an international basis, and systems used in various countries for volume correction and conversion are being correlated, to provide oil companies the basis for more accurate determination of actual volumes of crude and products handled particularly in foreign trade.

The work to this end, which has been carried on for over ten years by groups of U. S. and British petroleum technologists, has been broadened to include the metric system of volume measurement and conversion. This brings into the standardization program the oil companies in France, Belgium, Holland and other countries using the metric system.

The oil measurement project, sponsored in this country by the American Society for Testing Materials and in England by the Institute of Petroleum, has far wider potential significance than as used only in oil company foreign trade operations. The actual practices used in measuring the volumes of products in some 40 types of tanks have been reviewed to improve their accuracy.

Include Full Range of Products

Thus methods of tank calibration, tank gaging, sampling and temperature determination will be provided which will be of practical service to all oil companies in measuring more accurately the volumes of oil they are handling. The range of products included is from the light liquefied petroleum gases to heavy fuel oils and asphalts.

Crude oil is also included in the joint U. S.-British oil measurement standardization program. However, it is recognized that in this country API Code 25 for Measuring, Sampling and Testing Crude Oil, first brought out in 1930 and now in its seventh revision, supplies adequate data for volume measurement of crude.

In brief, the oil measurement project can be described as an effort to provide oil companies with as detailed and accurate knowledge for the determination of volumes of oils handled as modern accounting systems provide for determining the funds handled.

"Any oil company's auditing system will give an accurate check on every penny of any transaction," said L. C. Burroughs, New York, assistant to the vice president for manufacturing of Shell Oil Co., Inc., who has headed the ASTM oil measurement project since 1933. "However, funds in currency can be actually counted. Oils are handled either by volume or by weight. Either manner requires a calculation, where error may occur. Further, a conversion in volume from observed to a reference temperature may be required, another chance for error. In shipping to other countries, two different conversion systems may have to be used. So the oil company may find large shortages or overages in its inventories due to inherent inaccuracies in oil measurement practices."

An important part of the oil measurement project has been the preparation of the conversion tables—37 in number—for the temperature and gravity correction of volumes, inter-conversion of weights and liquid measure, conversion of units of measurement from the system of one country to that of another, and so on. The tables are entered in degrees of API gravity for use by U. S. oil companies, in specific gravity for use by British oil companies, and in density for the metric tables, for the use of companies in countries using the metric system.

The conversion tables, it is proposed, will supplement the U. S. Bureau of Standards Circular C 410, "Tables for Petroleum Oils", which has been accepted by oil companies in this and other countries since 1915 for volume corrections for temperature and gravity, and they will include additional tables.

The work on the oil measurement project in this country is being carried on by Sub-committee 15, Measurement and Sampling, of Committee D-2 on Petroleum Products and Lubricants of the ASTM. Mr. Burroughs is chairman of this special committee. H. Hyams, Shell Petroleum Co., Ltd., is chairman of the Institute of Petroleum's Standardization Sub-committee No. 1 (Measurement and Sampling) which is directing the work on the project of the British technologists. The Institute of Petroleum promulgates test methods and specifications in much the same manner as the ASTM in this country. Table 2 lists the U. S. and British personnel engaged in the oil measurement project.

War Interrupted Program

The standardization program was interrupted during the war, but during this period the British technologists accepted the U. S. Bureau of Standards volume and gravity correction tables and these were calculated in terms of Imperial gallons. After the war the project was actively resumed. This past summer Chairman Burroughs, and J. G. Detwiler, The Texas Co., New York, a member of Sub-committee 15, spent many weeks in England and Europe in cooperation on the project with technologists of British oil companies.

Together with British technologists they attended conferences in Paris with delegates from French technical societies and with representatives from Belgium and Holland. At these meetings further arrangements were made to include the metric system of oil measurement in the program.

Following the discussions on the Continent it was decided to adopt 15° C. (59.0° F.) as the standard temperature for the metric system and the conversion tables are to be computed to give results as metric weights in line with the British and American practice. More was involved here than the conversion from one system of measurement to another, since the countries using the metric

TABLE 1—Personnel on Oil Measurement Standardization Program

Sub-Committee XV, Measurement and Sampling, of ASTM Committee D-2

Chairman, L. C. Burroughs, Shell Oil Co., Inc.
A. E. Becker, Standard Oil Development Co.
H. T. Bennett, Mid-Continent Petroleum Corp.
Bowman Brannon, Charles Martin & Co.
J. G. Detwiler, The Texas Co.
P. L. DeVerter, Humble Oil & Refining Co.
P. V. Garin, Southern Pacific Co.
M. T. Gay, The Texas Co.
N. J. Gothard, Sinclair Refining Co.
H. M. Hancock, Atlantic Refining Co.
B. J. Heinrich, Phillips Petroleum Co.
E. L. Hoffman, Socony-Vacuum Oil Co., Inc.
H. J. Kelly, Gulf Oil Corp.
A. J. Kraemer, U. S. Bureau of Mines.
W. F. Lowe, Natural Gasoline Assn. of America
C. H. Lyman, Standard Oil Co. of California.
C. A. Neusbaum, Standard Oil Development Co.
H. C. Packard, Shell Oil Co., Inc.
W. B. Ross, Pure Oil Co.
W. L. Shroeder, E. W. Saybolt & Co.
W. E. Scovill, Standard Oil Co. (Ohio)
Norman Thompson, Sun Oil Co.
F. D. Tuemmler, Shell Development Co.

British Institute of Petroleum—Standardization Sub-Committee No. 1 (Measurement and Sampling)

Chairman, H. Hyams, Shell Petroleum Co., Ltd.
Deputy Chairman, W. F. Jelffs, B. & R. Redwood
T. C. R. Baker, Anglo-American Co., Ltd.
O. A. Bell, the War Office
J. A. Berriman, "Shell" Refining & Marketing Co., Ltd.
J. E. Byles, Government Laboratory
G. A. Claydon, War Office
P. Docksey, Anglo-Iranian Co., Ltd.
F. Gill, Anglo-Iranian Co., Ltd.
M. H. Hoffert, Anglo-Iranian Co., Ltd.
G. W. Lepper, Ministry of Fuel and Power
G. H. Lines, Air Ministry
F. Mackley, "Shell" Refining & Marketing Co., Ltd.
J. Mason, Ministry of Supply
W. L. F. Nuttall, Ministry of Fuel and Power
E. Stokoe, "Shell" Refining & Marketing Co., Ltd.
F. Tipler, Anglo-American Oil Co., Ltd.
A. T. White, B. & R. Redwood
D. Wyllie, Admiralty

system use a different system of coefficients of expansion than in the U. S. and England.

In addition to the preparation of the conversion tables, many technical problems have arisen, in the course of the project, in working out the tank calibration, tank gaging, sampling and temperature determination methods which are a part of oil measurement operations. Considerable research and experimental work has been done by oil companies in this country in arriving at these methods.

For example, oil measurement procedure among U. S. oil companies has not provided for calculation of changes in volume of tanks due to thermal expansion of the tank metal, or due to expansion of tank metal caused by liquid head of the contents. On the former problem, the technologists concluded that not enough data was available to enable an estimation of the temperature of the tank shell when the oil and outside temperatures were known. Therefore, it was difficult to obtain knowledge of the particular expansion of the steel, so original experimental work has been done on this among other subjects. Again, data had to be worked up on the thermal expansion of metal gage tapes, to provide for accurate gaging of tank contents at higher temperatures.

The present status of the various sections of the joint oil measurement standardization program is summarized below, as described by Chairman Burroughs. In general the procedure has been to have preliminary drafts of the various methods and practices prepared by the interested group in each country. The preliminary drafts are then exchanged and controversial points as to apparatus and procedure are ironed out before the official publication of the method. Publication in this country will be by the ASTM and in England by the Institute of Petroleum.

1—Sampling: Drafts of this procedure were prepared by a group from Sub-committee 15 of D-2 and sent to the Institute of Petroleum for comment. It is planned to publish the draft as approved by both groups in 1949, as a tentative standard

L. C. Burroughs, assistant to the vice president for manufacturing, Shell Oil Co., Inc., New York, chairman of Subcommittee 15 of ASTM Committee D-2, who is directing the work in this country on the oil measurement standardization program

test of ASTM. This would replace the present ASTM method D270-33, Sampling Petroleum and Petroleum Products, which was published in 1927 and adopted as standard in 1933. This is the only test having to do with oil measurement procedures which is included in present ASTM test methods.

2—Temperature Determination: Draft of the proposed procedure here was prepared as an activity of Subcommittee 15 and is to be published for information only in the current manual of Committee D-2, to secure comment and suggestions from oil companies.

3—Gaging Procedure: Preliminary draft of this method has been prepared and is being studied for comment and revision in both this country and England.

4—Oil Measurement Tables: The work of preparing the tables has been divided between the ASTM committee and an Institute of Petroleum group. Details of the proposed method of publication in this country have not finally been arranged. To facilitate their practical use, an explanation and example of its use will be given for each table.

5—Tank Calibration: This is considered the biggest individual job of the oil measurement standardization program because of the many technical problems involved in determining tank capacities under various conditions of shape of tanks, metal temperature, liquid head and other factors. Experimental work is being carried on within Sub-committee 15 on this phase of the program. In connection with this subject codes will have to be prepared for the many types of tanks used for the storage of crude and products.

Investigate Wide Field of Subjects In Esso's Modern Laboratory

IN ADDITION TO the main line of research on petroleum fuels and lubricants which will be carried on at the new Esso Research Center of Standard Oil Development Co., at Linden, N. J., plans include studies on new plastics, new ingredients for paints, insecticides, detergents, process oils and many basic chemicals for industry.

The research facilities and equipment provided are as modern as the 580-ft. long, four-story structure housing the laboratories and administrative offices, which was fittingly opened Oct. 14, Oil Progress Day. It will provide working quarters for 750 chemists, physicists, engineers and service department personnel.

This first unit of the SOD Research Center is part of an $8,000,000 program for expansion of research facilities which the company announced in 1945.

"The modern industrial research laboratory is a place where the sciences meet," said E. V. Murphree, president of Standard Oil Development Co., in a talk made in connection with the opening of the Research Center. "It is here that the whole great force of skill and knowledge in chemistry, physics, engineering and other sciences can be focused on a problem."

This principle of providing complete facilities for the interchange of data among the working staff and between the laboratory force and the outside scientific world has been followed in the design of this first unit of the center, in addition to installing the latest in scientific instruments in the 80 separate laboratories in the building.

The technical library, housed on the fourth floor, is recognized as playing an important part in the teamwork required for efficient operation of a research laboratory. Its mile and a half of bookshelves hold 25,000 volumes making it one of the largest industrial libraries in the country. The library staff numbers 24 persons, of whom 13 hold at least bachelor's degrees in chemistry and engineering. Among them they can read technical articles written in practically every European language.

The library receives more than 400 periodicals regularly, which are reviewed and abstracts prepared of all articles pertinent to the work of the company's technical groups. Almost 9000 abstracts were prepared during the first six months of this year. The library's card file index, which is arranged by subject, author and patent number, contains over 1,500,000 cards with abstracts of more than 250,000 patents, books and technical papers and documents.

An article describing the Research and Development Facilities of Sinclair Refining Co. at Harvey, Ill., which were formally opened Oct. 22, will be carried in the December issue of PETROLEUM PROCESSING.

Another facility of the Linden laboratory to aid in the interchange of scientific knowledge is the wood-paneled auditorium on the main floor, which accommodates 150 persons in the tiered rows of comfortable seats. It has specially-designed acoustical features which permit a normal speaking voice to be heard from any part of the room without amplification devices. Projection, sound and lighting equipment are controlled from a booth. Other unusual equipment includes facilities for tape recording of speeches, and wall panels, controlled from the speaker's stand, that slide away to provide extensive blackboard space.

Some of the individual offices are provided with blackboards and chairs and table for conferences of a small group on selected subjects. Voice amplifying devices are installed in some of the laboratories so that experimental work going on can be described above the noise of test apparatus in operation.

The laboratory for Physical Methods of Analysis is typical of the modern approach to petroleum research provided at the Esso Research Center. Spectrographic methods of analysis applied include infrared, ultraviolet and mass spectrometry, to determine the individual compounds or compound types in hydrocarbon mixtures. They are employed, in motor and aviation gasoline production, to control processes to achieve the maximum yields of high octane components.

In the combustion laboratory "flame velocity" measuring equipment has been developed to measure the rate of burning of a fuel-air mixture as a fundamental factor in combustion processes. This instrument is essentially a glass pipe which is filled with a fuel-air mixture from metering equipment at one end. The mixture is then ignited by means of a spark plug on the other end. The length of time it takes the flame to travel from one end of the tube to the other is measured by means of an electronic timer-photocell combination which can measure time intervals down to a thousandth of a second. Extensive studies are also being carried on here on the performance of fuels in jet plane burners.

In the chemical specialties laboratory work being carried on in chemical products manufactured from petroleum includes:

Toluene produced by hydroforming for use as a solvent in paints and varnishes.

Cyclohexane for use as a raw material in the manufacture of nylon.

Naphthenic acids combined with metals such as lead to make materials which promote the rapid drying of paints.

Ethylene as the initial raw material for wide use in the manufacture of chemicals.

Synthetic detergents made from petroleum raw materials to replace soap manufactured from animal fats.

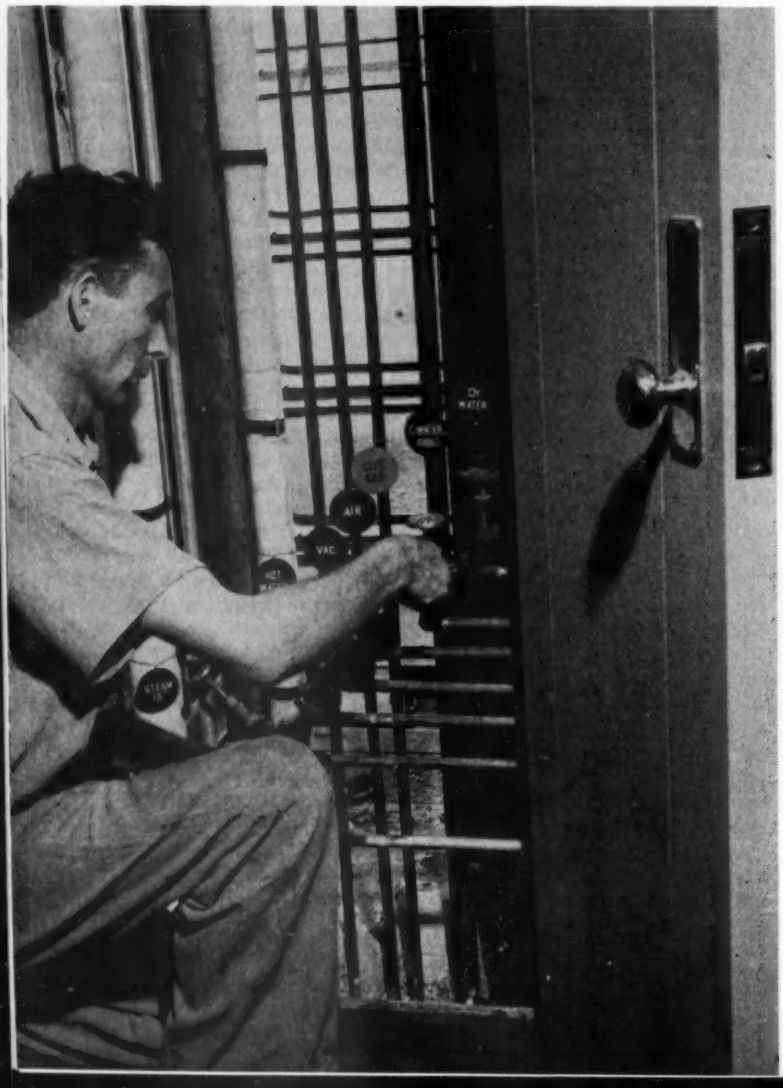
The structure of the laboratory and office building of the Esso Research Center consists of a main wing 580 feet long and 60 feet wide, with three office wings 70 by 42 feet. It is constructed of brick around a steel frame and is functionally designed to the exacting requirements of a modern research institution. Movable metal partitions form the laboratory and office side walls so that each room can be altered in size to meet the requirements of work being done there. The entire building is air conditioned in such a way as to prevent accumulation of fumes and gases, and it contains the most modern safety devices.

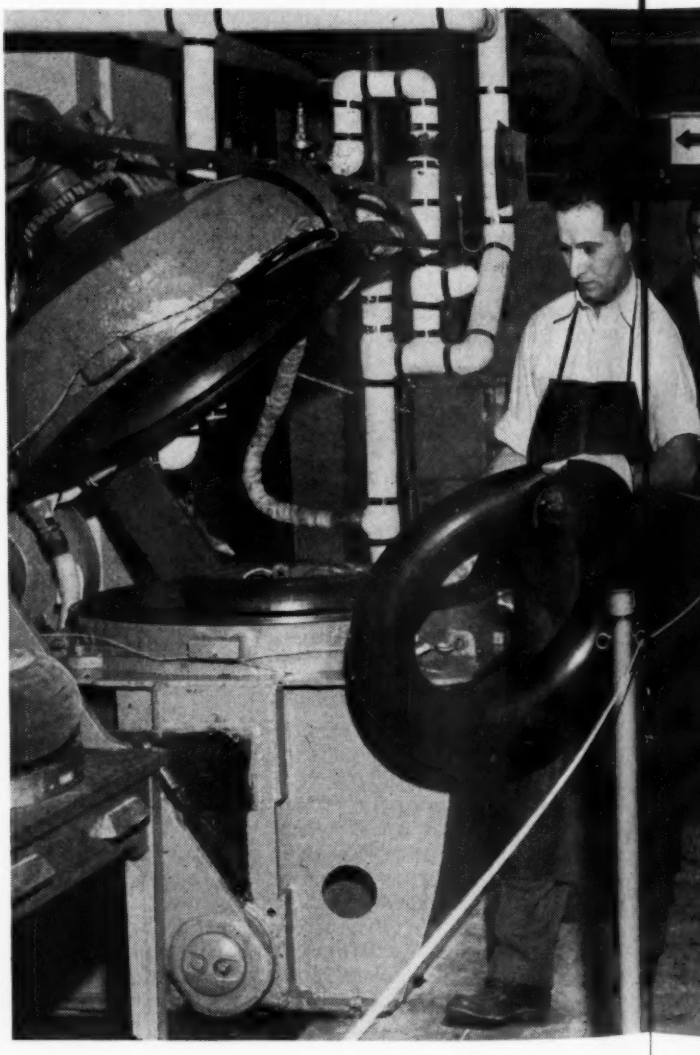
The laboratories themselves are fully equipped for general research purposes, including alternating and direct current, illuminating gas, compressed air, vacuum, nitrogen, chilled water and steam. These services are supplied from a basement service section and are distributed to the laboratories through pipes and wires carried in the corridor walls.

Photos of the Laboratory On the Next Two Pages

New laboratory and office building of the Esso Research Center, at Linden, N. J., has 80 laboratories, 250 offices, complete technical library

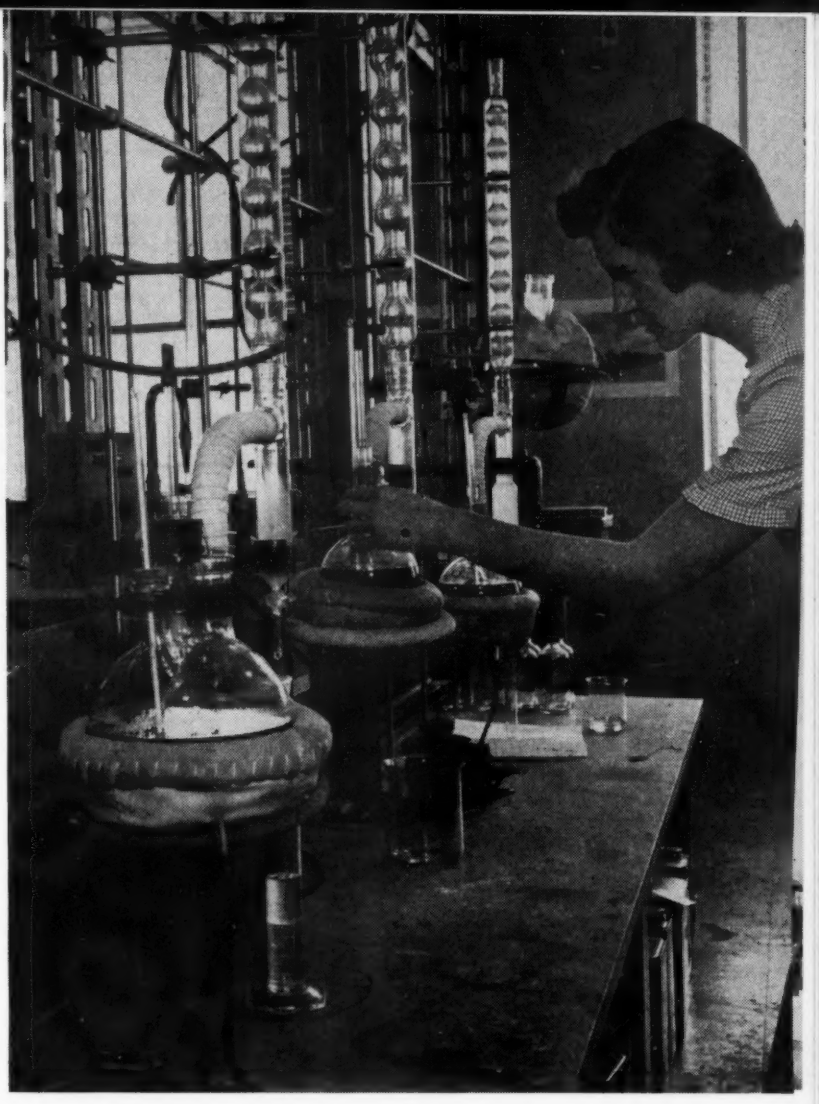
Steam, water, nitrogen, compressed air, vacuum and city gas are supplied to the individual laboratories, carried from a basement service section through piping and conduit in the corridor halls





For research and demonstration purposes commercial Butyl rubber inner tubes are manufactured in the rubber section of the Esso Research Center laboratory. The tube-making operation begins with the extruder feed mill and extends through final vulcanization

COVER PICTURE this month shows main entrance wing of new Esso Research Center



An assistant checks temperatures in a distillation setup in the lubricants and additives section polymer laboratory

The wood-paneled auditorium on the main floor accommodates 150 persons in tiered rows of comfortable seats. Projection, sound and lighting equipment are controlled from a projection booth. Facilities are provided for tape recording of speeches. Blackboards are concealed behind two sliding panels, one on each side of the stage

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Improve Efficiency in Mercaptan Extraction Using Cascade-Type Fractionating Trays

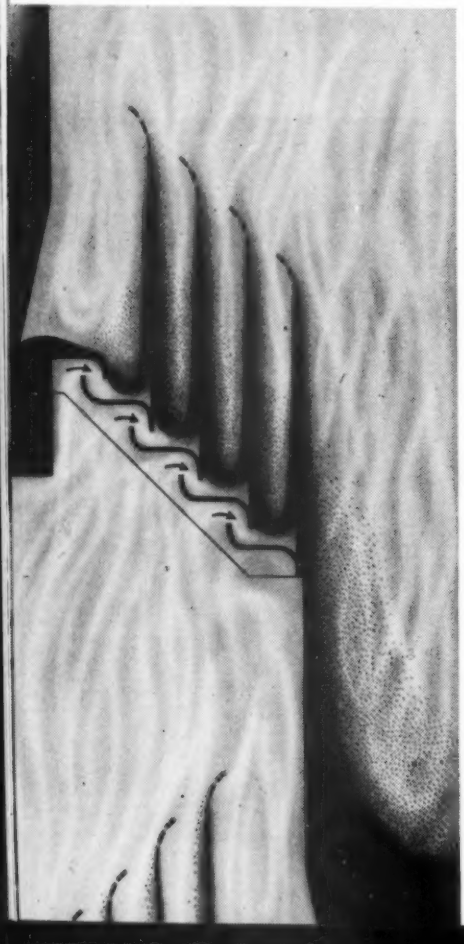
By F. DUANE FUQUA
Koch Engineering Co., Inc.

AN IMPROVED fractionating tray for liquid-liquid contacting will be put to full-scale use in the mercaptan extraction towers of a gasoline treating unit now under construction at the East St. Louis refinery of Socony-Vacuum Oil Co., Inc.

Experimental work during recent months with a small-scale model at the Socony plant has shown the tray to be superior in efficiency to either packed or bubble columns. Tests showed it offers greater capacity and lower first cost because of reduced size requirements. Used previously with success in a great number of petroleum processing plants for conventional vapor-liquid fractionating, the tray is adaptable to any process involving contact of two immiscible liquids; for example, liquid treating or solvent extraction. Trade-named the "Kaskade" tray, it is manufactured by the Koch Engineering Co., Inc., of Wichita, Kans.

The liquid-liquid contacting action through the tray is illustrated in Fig. 1, and is essentially the same as that of the vapor-liquid Kaskade tray.

Fig. 1—Diagram of action in the liquid-liquid contacting Kaskade tray



Mr. Fuqua has been associated with the petroleum industry almost since graduation from Texas Technological College in 1937 with a B.S. in Chemistry. After two years as a high school science teacher, he joined Phillips Petroleum Co. as a chemist and engineer. This was followed by employment as a process engineer with Associated Refiners and Bell Oil and Gas Co. He has been with Koch Engineering Co., Inc. since 1947, as Process Engineer.

Heavy liquid flows through the downcomer from the tray above and cascades over a series of troughs and through the perforated baffles. The disengaged portion of the light liquid passes between the baffles in parallel streams to the tray above. Each screen is bent back so as to almost touch the baffle of the preceding trough. Any of the heavier liquid carried upward by the lighter liquid contacts the perforated baffle, which reverses the direction of the heavier liquid from its upward path. Final disengaging of the two phases takes place in the downcomer.

Socony-Vacuum had already found the contacting efficiency and capacity of a bubble tray column to be superior to any packed column in treating gasoline with tannin solution for mercaptan removal. The company therefore placed in operation in a commercial unit at East St. Louis a 30-tray bubble column which had served previously as a depropanizer. When the need arose for specifying columns for two new treating units, the management suggested experimental work on the Kaskade device, because bubble tray performance was still not satisfactory.

A plastic model, approximately similar in operation to that shown in Fig. 2, was supplied for the tests. Earlier model lacked many refinements incorporated in the later design; it was rectangular in cross section, required considerable external bracing, and most important, lacked disengaging space above the tray level. It was used as a mercaptan extraction column in tannin solutizer treating, and was operated in parallel with the existing 30-tray bubble column. A flow diagram of the experimental treater is given in Fig. 3. The heavy liquid (tannin solution) is fed into the model above the tray; the lighter liquid (caustic prewashed gasoline) enters near the base of the model. Orifice meters on both inlet streams were used for flow measurement.

The two features studied—capacity and efficiency—were compared with results obtained in the plant bubble column. Superficial velocity of gasoline, taken as a measure of capacity, was varied from 0.53 to 2.63 ft./min. Treating solution rate was varied from 9 to 60% of the gasoline volume. Results of tests in the plastic model are shown in Table 1.

Contacting efficiency of the Kaskade tray was determined empirically by comparison with mercaptan removal in the laboratory. It was found that by vigorous shaking of gasoline with treating solution until mercaptan content was reduced no further by additional shaking, 75% mercaptan removal could be obtained. Table 1 indicates, with approximately 20% of treating solution (average operating conditions), mercaptan removal through one Kaskade tray under test conditions was 56%. The comparative efficiency between the test and the laboratory run is

TABLE 1—Operating Results of Experimental Treating with Koch Kaskade Tray Model

Gasoline Rate—gpm	Linear Velocity of Gasoline in Kaskade Tray Model—Ft./Min.	Necessary b/d Gasoline Rate on 3'-9" Extraction Column to Give Same Linear Velocity	Copper No. of NaOH Prewashed Gasoline Feed	Copper No. of Treated Gasoline	Tannin Treating Solution Rate gpm	Tannin Treating Solution Vol. % Gasoline	Carry-over Pounds/1000 Bbl.
3.80	1.01	2850	18.0	8.00	0.78	20.5	4.25
4.00	1.07	3050	18.0	7.40	1.00	25.0	5.60
5.25	1.40	3950	18.0	8.00	1.00	19.0	5.25
6.60	1.76	5000	18.0	7.40	1.44	21.8	5.88
7.85	2.10	5950	16.0	9.20	0.84	10.7	5.00
2.00	0.53	1500	16.0	6.80	0.60	30.0	2.67
2.00	0.52	1500	16.0	5.20	1.20	60.0	4.12
7.60	2.03	5750	16.0	8.80	1.20	15.8	6.25
9.80	2.63	7450	16.0	10.0	0.90	9.2	7.82

TABLE 2—Comparative Costs of Gasoline Caustic Wash Towers

	Liquid-Liquid Kaskade Tray Column	Packed Column
Gasoline Treated b/d	3600	3200
Superficial Velocity ft./min.	2	1
Column Diameter, ft.-in...	3–0	4–0
Height of Column, ft.-in..	27–0	42–0
Height of Packed Section, ft.-in.	....	28–0
Linear Feet of Packing, ft.-in.	....	20–0
Kaskade Trays	7	....
Theoretical Contacting Stages	5.0	5.0
Column Material	Carbon Steel	Carbon Steel
Tray Material	Carbon Steel	....
Packing	....	Carbon Rings
Cost of Packing.....	....	$1740.00
Cost of Kaskade Trays...	$810.00	....
Cost of Vessel	1170.00	2400.00
TOTAL COST	$1980.00	$4140.00

therefore 56 divided by 75, or 74.7%. In this same manner the comparative efficiency of the bubble tray was found to be 35 to 40%, or approximately half that of the Kaskade device.

The use of a transparent plastic model permitted visual study of the contacting between the two liquids, which appeared to be excellent. Mercaptan reduction, checked by copper number, substantiated this conclusion. Carry-over of treating solution above the tray did not exceed 7.8 lbs./1000 bbls. at any of the gasoline rates investigated, even though the disengaging space above the tray was only 15 in. and considerable turbulence was encountered at times below the tray at the gasoline feed inlet. The maximum gasoline rate investigated was 2.63 ft./min., a rate 160% as great as the maximum attained in the plant bubble tower.

One improvement made as a result of the studies with the plastic model was in the design of the baffles. Whenever any entrained particle of the heavier liquid would strike the baffle, its direction would be rapidly reversed. Because the perforated baffles were bent backward only partially, as in the standard design for the vapor-liquid tray, it was possible for some entrained material to pass up to the next tray section without contacting the baffle. In the new design, each baffle is bent back to nearly touch the preceding baffle. This makes it almost impossible for entrained particles to pass through without being coalesced by striking the baffle.

The plastic model shown in Fig. 2 was subsequently used for further experimentation in liquid-liquid contacting. Various flow rates of naphtha (sp. gr., 0.82) and water were employed, and the action observed visually. Naphtha rates ranged as high as 5 ft./min. superficial velocity, with the water operating up to 75% of the naphtha rate. Carry-over of the heavier liquid was negligible.

The superiority in efficiency for the Kaskade tray is due to the fact that contacting area and disengaging space are essentially separated. Contacting takes place in the troughs. Disengaging occurs between and on the perforated baffles and in the downcomer. In the case of a packed column, both actions take place in the same area. Since flow is not directed, channeling is prevalent, which restricts contacting units to small diameters, limiting capacity and encouraging carry-over.

A comparison of initial installation costs for a liquid-liquid Kaskade tray column with those for a packed column for caustic treating of gasoline showed that for a daily throughput approximately 12-1/2% greater, a saving of about 52% could be realized (see Table 2). For a higher pressure system, such as butane or propane washing, the saving would be even greater.

The tray is adaptable to fabrication in a wide range of metals and alloys, such as lightweight carbon steel, stainless steel, Monel, copper, and aluminum. Tray sections can be installed through a manway. Downcomers are bolted to trough sections within the tower. The sections are fitted into a plate mounted on a supporting ring welded to the tower shells. Hold-down bars hold the sections firmly in place on the plate. The perforated baffle sections slip into slots provided on the solid portion of the trough overflow.

To date the smallest tray in commercial use as a vapor-liquid fractionator is 14 in. diameter. This small size requires the tower to be flanged at each tray. The smallest standard installation is in a 2-ft. 4-in. diameter tower. There is no maximum diameter tower to which these trays are limited.

The author wishes to express his thanks to the Socony-Vacuum Oil Co., Inc., for permission to publish this article, and to Messrs. C. P. Baker and D. P. Parker, of the same company, for their cooperation in supplying experimental data.

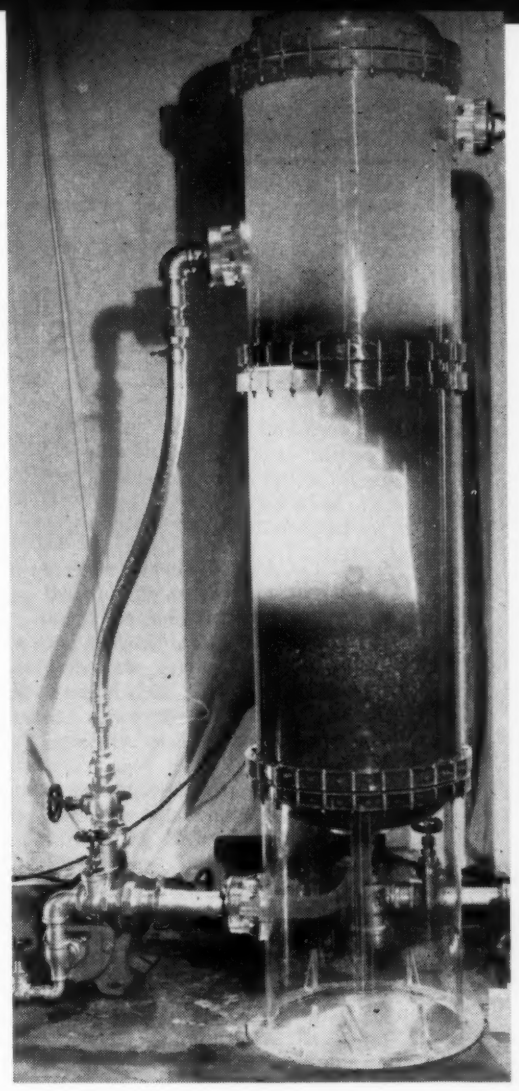


Fig. 2—Cylindrical plastic tray model used for later experiments. Vessel in earlier studies was rectangular in cross section, and lacked proper disengaging space above the tray level

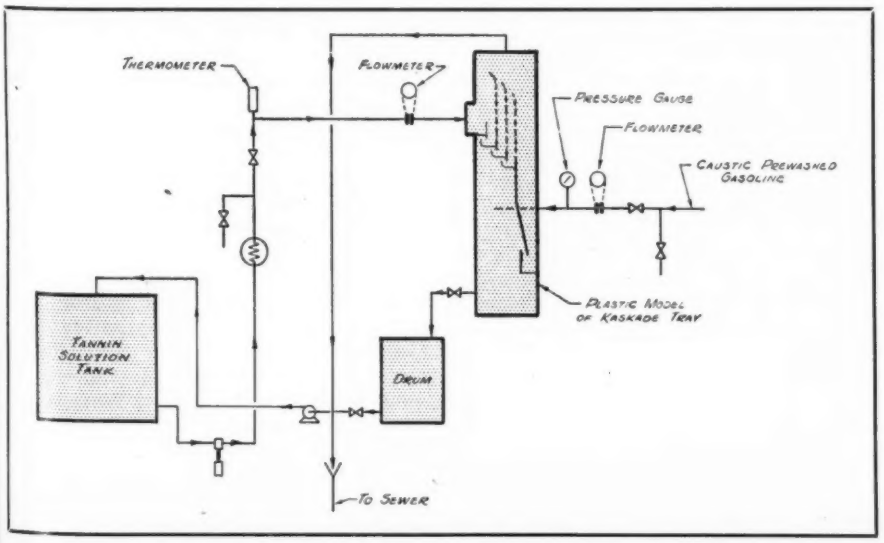


Fig. 3—Flow diagram of experimental gasoline treating unit

Higher Propane Yields in Gasoline Plants by Hypersorption Process

By D. P. THORNTON, Jr.

Assistant Editor Petroleum Processing

Staff Report from Los Angeles

APPLICATION of the new Hypersorption process in natural gasoline plant operations to achieve a higher rate of extraction of propane of the required purity was described as economic, at the 23d Annual Fall Meeting of the California Natural Gasoline Assn., in Los Angeles, Oct. 8.

Over 98.5% propane recovery can be secured, it was stated, with substantially 100% yield of butane and heavier. Reasonable payouts on the process may be achieved, it was said, from natural gas containing as little as 1.5% propane as a component.

The presentation of the Hypersorption process was in a talk by Howard Kehde, Foster-Wheeler Corp., New York. At the same CNGA meeting, a paper entitled "Propane Recovery by Absorption" presented by Ludwig Kniel, Lummus Co., New York, discussed the use of fractionating absorbers of improved design to obtain the desired high propane recovery. (This paper is published starting on page 1066 of this issue.)

The supply and demand outlook for propane was discussed in a paper by T. W. Legatski, assistant director of research, Phillips Petroleum Co., Bartlesville, entitled "Propane's Place in the Sun." The requirements for propane coming from many sources, he said, will tax our facilities to meet the increasing demand. There is an incentive to build new recovery facilities, and also for operators to find the ways and means to even out the seasonal demand fluctuations which constitute one of the major problems of natural gasoline plant operators.

Registration at the CNGA meeting exceeded 700, despite the strike at West Coast oil plants which kept away many supervisory and operating personnel. Attendance was large at the meetings to hear the papers and talks arranged by E. R. Millett, Jr., the association secretary and the program committee headed by Randal Maass, General Petroleum Corp.

Hypersorption

The talk on Hypersorption by Mr. Kehde is believed to be the first public discussion of the use of that process as a means for high propane recovery in high purities. Previous papers and articles on the process have dealt with it primarily as a means for recovering high yields of ethane and other light gases from mixtures of hydrocarbons.

(The data reported below has been written from notes taken during the meeting, since Mr. Kehde did not present a formal paper and no prepared text is available — Editor.)

Basically the process depends on the adsorption of selected components of the gas by activated charcoal moving through a tower so that two or more streams result, depending on the separations desired. Flow is as shown in Fig. 1, representing the first commercial Hypersorption unit, used by Dow Chemical Co. at Midland, Mich., in the recovery of small concentrations of ethylene from a hydrogen-methane stream.

A 10-40 mesh carbon particle is used, flowing continuously from the top of the Hypersorption tower under control of the flow mechanism shown in Fig. 2. Feed enters through a gas engaging tray which provides uniform distribution of incoming gas with the carbon, and where the heavier components of the mixture are adsorbed. That portion immediately below feed injection is the rectifying section, where the adsorbed components encounter a counter-current reflux of the bottoms product. This serves to displace any of the lighter overhead components originally adsorbed, which pass through the adsorption section to the cooler section and are split into two streams.

The major overhead stream is disengaged from the carbon just before reaching the cooling section. This is labeled "discharge gas" in Fig. 1. The balance of the overhead passes through the cooler section, dehydrating the stripped carbon entering the Hypersorber and leaves at the top of the column, to join the lift gas system. A part of this stream is shown as "purge gas" in Fig. 1. The lift gas returns stripped carbon to the top of the column.

Carbon saturated with bottoms product enters the stripping section, a vertical tube bundle externally heated by a Dowtherm unit. Complete stripping is obtained by inject-

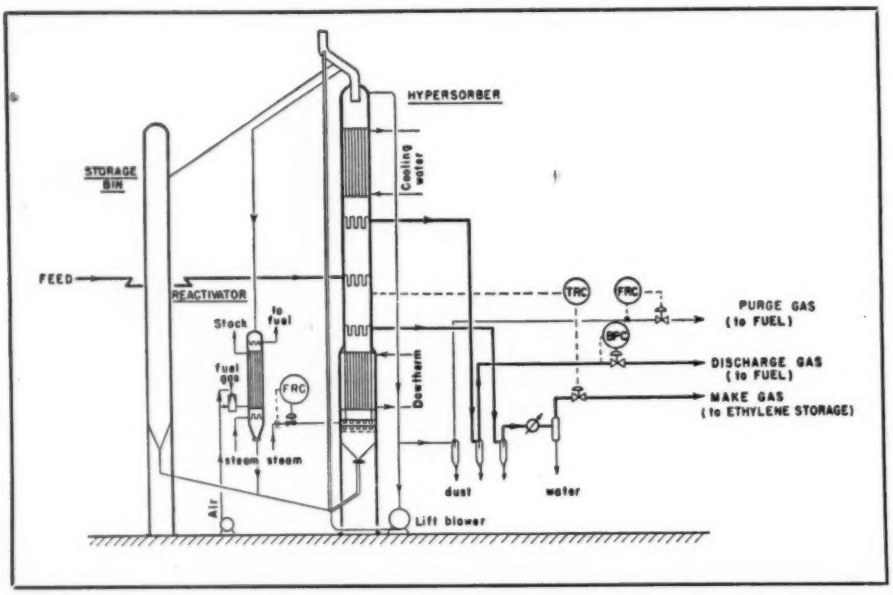


Fig. 1—Flow diagram of commercial Hypersorption unit, extracting ethylene from a methane-hydrogen mixture

ing steam below the heating section, through which it passes countercurrently. Stripped bottoms product and steam leave the column through a tray just above the heating section and below the rectification section.

Control of carbon flow is obtained by the mechanism illustrated in Fig. 2. This is a moving tray with elliptical downcomer tubes, so aligned with corresponding tubes and slots in stationary trays above and below that half the downcomers are filling and half discharging at the end of each stroke. The moving tray is actuated hydraulically and makes 8 cycles per minute.

Control of desired adsorption is maintained by a very simple temperature control which happens not to be critical of small changes in overall operation of the unit. Since adsorption on charcoal is exothermic and the temperature is characteristic of the materials being adsorbed, the controller is set to hold bed temperature in the rectification section on the plateau resulting from the adsorption of the reflux bottoms product. This point is evident in the temperature gradient chart of Fig. 3.

Make-gas flow is controlled by this temperature controller, while column pressure is maintained by a back pressure regulator on the overhead product stream. Purge gas flow rate is held constant by a flow controller. The column is intended to operate slightly above a minimum adsorbent-to-gas ratio, below which sharpness of separations falls off rapidly, and thus yields essentially complete separation of desired constituents. In other words, the carbon rate is designed to be capable of adsorbing more of the heavy components than necessary to meet minimum requirements of the separation. This assures positive displacement of the light ends overhead, keeping them out of the bottoms product, and simultaneously prevents heavy ends from contaminating the overhead. Likewise unit upsets, making contaminated products, are greatly minimized and stable operation assured.

TABLE 1—Raw Gas Feed and Product Streams from Hypersorption

Component, %	Raw Gas	Bottoms Stream	Overhead Stream
Methane	86.79	....	93.0
Ethane	6.44	0.2	6.9
Propane	6.51	95.9	....
Butanes	0.25	3.7	....
Pentanes plus	0.01	0.2	....
	100.00	100.0	99.9

A hypothetical Hypersorption operation for propane recovery was described by Mr. Kehde. It could be designed for processing either wet or dry gas of the composition shown in Table 1. Required was 90% propane recovery and substantially all of the butanes and heavier. Design compositions of overhead and bottoms products using Hypersorption also are included in Table 1. Feed rate in the hypothetical case was set at 27,650 Mcf per day, 150 psi, of the dry raw gas.

Plant make, as developed by Mr. Kehde for this example, indicated a recovery of 50,000 gal./day of propane and 25,800 Mcf daily of residue gas (with 1.6% of the overhead used as plant fuel). Design requirements were met with 98.5% propane recovery and substantially 100% yield of butane and heavier.

In describing the hypothetical plant, operating substantially the same as the ethylene unit shown in Fig. 1, it was stated that three feed inlet trays would be used to assure even feed distribution and a tower 7 ft. 6 in. in diameter by 130 ft. high would be required, handling a carbon circulation of 47.3 tons per hour from the initial carbon charge of 40 tons. It was further found that 18.2 tons of carbon would be required as makeup the first year, 8.5 tons the second and total makeup for the subsequent three years, 15.9 tons. Dissipated heat load from the stripper would amount to 13,000 MBtu per day.

Plant costs, utilities, operating expense and anticipated payout are given in Tables 2 and 3. Although royalties are not included, Mr. Kehde said their inclusion would make no substantial change in payout time. The investment total of $542,000, operating cost of $169,000 and payout time of 0.61 year before taxes were represented as less than half that of an absorber unit recovering only 75% of the propane, against 98% propane by Hypersorption. Reasonable payouts may be achieved, he declared, from natural gas containing as little as 1.5% propane.

He also stated, in answering questions brought up during the discussion following his talk that the hypothetical Hypersorber described was intended to add to a going plant having incidental propane recovery. In order to keep reactivator size and cost low, it was intended that a wet gas first would be depentanized in the plant's existing absorber, to cut C_5+ content to 0.01% and below. Further, it is not necessary to dry the incoming gas, while the dry gas

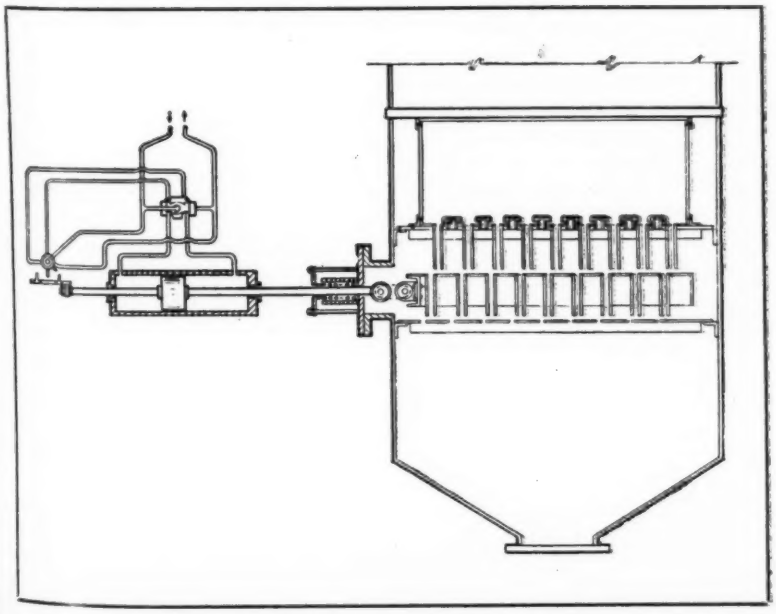


Fig. 2—Carbon flow controller apparatus on Hypersorption tower

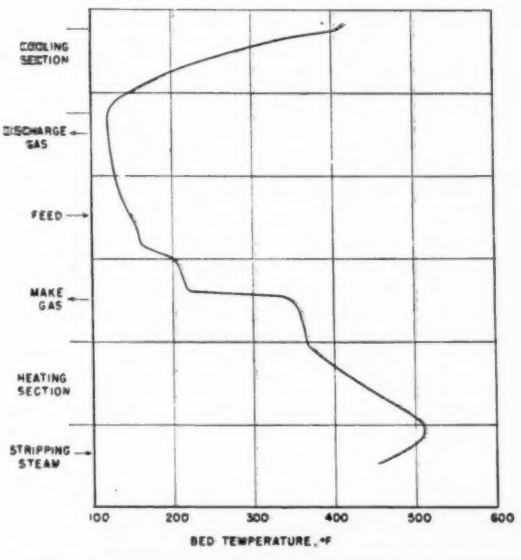


Fig. 3—Temperature profile across a Hypersorber. Control point for carbon rate is the plateau between 220° and 330°F.

TABLE 2—Utility Requirements for Hypersorber Unit Recovering 98.5% Propane

Fuel:	
Dowtherm furnace, Mcf.	16.7
Reactivator, Mcf.	1.6
Total, 1067 Btu gas, Mcf.	18.3
Cooling water (25° F rise):	
Hypersorber cooler, gpm.	1000
Product coolers, gpm.	400
Total, gpm.	1400
Steam:	
Stripping, lbs./hr.	4000
Blower drive, lbs./hr.	5850
Total, lbs./hr.	9850
Electricity, Kwh.	10

TABLE 3—Investment and Operating Cost Data for Hypersorber Recovering 98% Propane

Item	
Capital Investment:	
Plant construction	$490,000
Charcoal, initial charge	52,000
Total	$542,000
Operating Costs, $/year:	
Fuel gas, 10 c/MMBtu	16,600
Cooling water 6.7c/1000 gal.	48,000
Steam	20,900
Electricity	2500
Fixed expense (5% of plant cost)	24,500
Maintenance (5% of plant cost)	24,500
Charcoal makeup (5 year average)	11,100
Labor (1 man per shift plus supervision)	21,000
	$169,000
	108,500
Amortization, 5 years	$277,600
Other expense, administrative, etc.	57,500
Total, expense	$355,100
C_3 production, gals./year 18,100,000	
Cost, per lb. 1.53c	
Revenue:	
Value of product, at 6.8 c/gal.	$1,230,000
Less total expense	335,100
Total	$894,900
Payout, before taxes, etc. 0.61 years	

will have a dew point of −100° F. Hydrogen sulfide does not interfere, and will be found in the C_2 and C_3 streams; practically none is found with the methane.

Other points about the unit thus brought out are that: pressure drop is 3 psig maximum, units are designed up to 500 psi and pressures up to 1000 psi are being considered in the pilot plant stage. In the event a Hypersorber is installed behind an oil absorber, precautions are necessary to de-entrain oil vapors to reduce load on the reactivator. Should an absorber "puke," it might take up to 24 hours to get the Hypersorber settled down again. Ordinarily, a Hypersorber may be expected to run 97% of the time, or 354 days annually. If desired a Hypersorber may be designed with several rectification sections, to provide streams, for instance, of C_1-C_2 overhead, essentially pure propane as a side stream and butane and heavier as bottoms.

Propane's Place in the Sun

Potentially available supplies of LPG hydrocarbons, propane and butane, far exceed the industry's present needs and, so long as crude is refined and we have natural gas supplies, there will be an abundance of LPG hydrocarbons for sale in whatever markets prove to be the most lucrative. These facts were brought out by T. W. Legatski, Phillips Petroleum Co., in his paper before the C.N.G.A. entitled "Propane's Place in the Sun." He stated that recent estimates of potentially available butane place the volume at 163,000,000 bbls. annually. Best estimates based on analyses of many field gas samples and refinery product streams indicate there is at least one barrel of propane available for every barrel of butane.

Of total butane now available annually, only two-thirds is extracted and, of that, only one-third (35,000,000 bbls.) finds its way into other than gasoline blending operations. All the propane sold as LPG in 1947 was less than 10% of the potentially available supply. Compare this, he said, with the total potential supply of propane and butane, including the related unsaturates, of approximately 325,000,000 bbls. annually.

Nor is this the whole story, Mr. Legatski emphasized, pointing out that these supply figures are based on current producing and refining operations. No consideration has been given to possible changes in the character of oil and gas reserves occasioned by deeper drilling or of higher producing and refining rates. It is probable from present trends that the potential volumes of propane and butane may reach 500,000,000 bbls. annually. Even the jump from the present crude oil refining rate of 1,800,000,000 bbls. annually to 2,000,000,000 bbls. will increase these volumes substantially, he stated.

Looking at the demand picture, he continued, it is apparent the industry is continuing its rapid growth. In the four years from 1944 to 1948 total sales have more than doubled—reaching approximately 48,000,000 bbls. in the current year. In fact, he stated, while the probable 1948 consumption has been estimated as 20% greater than 1947, this figure is now believed to be conservative.

The new acceptance of LPG for house-heating is indicated by an estimate that at least 15% of all the so-called floor furnaces made are intended for use with this fuel. This may give a clue to how peak load problems may be at least partially solved, since the need for larger consumer storage was forcefully driven home the past two years when distributors were not able immediately to supply peak winter loads.

A very considerable unfilled demand exists for new industrial installations, limited by industry's ability to supply the fuel, Mr. Legatski stated. Many industrial firms normally using either natural or manufactured gas are installing standby storage of LPG to tide them over winter, when domestic heating loads force gas companies to curtail industrial deliveries.

Utilities likewise jumped their 1947 consumption 55% over 1946 and their interest shows every indication of continuing. Most of the increase last year was the result of using LPG to a limited extent throughout the year to offset shortages in primary supplies, and of course to fill standby storage for winter peak requirements.

Chemical industry requirements likewise will increase, it was stated, as new chemical plants are being located adjacent to plants producing LPG to assure their supply of these raw materials. Chemical demand was up 35% over 1946 last year.

All these, Mr. Legatski declared, "will tax our every facility to the utmost to meet this sky-rocketing demand. There is certainly an incentive to build new recovery facilities, and also for all of us to be thinking constructively of ways and means for correcting the seasonal load variations which constitute a current major problem.

"Heretofore, the mounting requirements for these materials have been met chiefly with adventitiously extracted propane and butane—i.e., by-products of our natural gasoline plant and refinery vapor recovery operations. From now on, the design objective in recovery projects will tend to shift more and more to complete recovery of propane. With the growing interest in ethane as a chemical raw material, it is even to be expected that there will be numerous cases where substantially complete ethane recovery will be the target."

Continuing, he pointed out that three principal problems confront the industry. First, the industry must supply facilities to meet a demand which has shown no signs as yet of leveling off.

Second, the small gasoline company particularly must decide how to go about capturing additional production most economically—whether to modify existing plants or scrap them for new ones.

Third, the question of evening out seasonal demand fluctuations is uppermost in the minds of producers as well as distributors. New large volume outlets, coupled with those resulting from intensive cultivation of special summer loads, should go a long way toward leveling out demand, it was said.

Such outlets, representing at present only partially-explored fields, were pointed out as: (1) domestic air-conditioning, (2) new utilities applications, (3) various applications in agriculture or in activities related to it and (4) use of LPG as premium automotive fuels.

Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

Data in answer to questions presented on these pages is supplied through the cooperation of authorities with the equipment and engineering companies of the Natural Gasoline Supply Mens Assn., among others. Readers are invited to submit queries on plant operating problems in their own work.

What is the best means of keeping absorption oil clean and within the desired average molecular weight range?

There are several ways of keeping absorption oil clean, making use of distillation. Some cycling plants make a fuel oil or kerosine having the same characteristics as their absorption oil, hence constantly discard a certain portion to salable products and make up from their daily product. Most plants cannot utilize this simple system.

A second method is to withdraw periodically the absorption oil from the system for redistillation to the desired boiling range. This requires an auxiliary supply sufficient to run the plant while the dirty oil is being restored.

A third, and preferable method, uses a purifier in a shunt circuit off the absorption oil system, and may be connected into the plant flow sheet in many ways. It continually withdraws a small part of the oil circulated, and returns clean oil to the system.

In one patented system a portion of the oil is withdrawn from the plant circulation into an auxiliary still. Here the oil is brought in contact with steam to be used for stripping in the main plant still. The latent heat required for oil evaporation is supplied by a heater tube bundle. Oil vapors and steam enter the still in the vapor phase.

The dirt and heavy ends, including sludge and other "muck" found in dirty absorber oil, remains in the auxiliary still or purifier where it accumulates until dumped by the operator. Thus, in effect, the only cost for cleaning the oil is in the first-cost of the purifier assembly and its installation. The small amount of heat required to vaporize the oil purified is recovered in the plant's main still. This heat is recovered in the stripping section of the still where the oil vapors are recondensed.

An additional advantage of this system is that the absorption oil is always clean and of desired average molecular weight. The muck which normally accumulates in exchangers and other heat-transfer surfaces never has a chance to deposit. The small amount of high temperature oil vapor entering the still aids stripping and can easily be accommodated without alteration in routine operating procedure. Operator's attention is limited to a few minutes, generally once a week or even over more extended periods.—Norman K. Rector, Petroleum Engineering, Inc., Houston.

What can be done to repair a concrete cooling tower basin which has been attacked by the cooling water?

One of the best methods of repairing disintegrated concrete is by means of "guniting," the spraying of a cement and sand mixture onto the affected areas. The mixture ordinarily consists of 1 part cement to 3 or 4½ parts of sand, mixed dry, which is hydrated as it leaves the spray nozzle by passing through a high pressure jet of water.

The following specifications are recommended for repairing disintegrated concrete cooling tower basins, as indicated in the accompanying Fig. 1.

All disintegrated concrete shall be removed by pneumatic tools or other approved method, exposing good hard surfaces of the original concrete. If removal of the disintegrated concrete does not produce a clean surface, then these surfaces shall be sandblasted, using the cement gun as a sand blast machine, before any "gunite" mixture is applied.

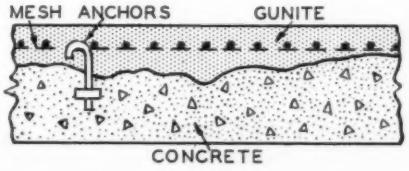


Fig. 1—Cross sectional view of cooling tower basin repaired with gunite

Reinforcing, consisting of 2 in. x 2 in. No. 12 & No. 12 galvanized welded fabric, shall be held in place by ¼ in. by 2 in. "gunite" lead anchors placed on required centers. "Gunite" mixture, 1 part cement to 3½ parts sand, shall be shot behind, around and over the reinforcing to the required thickness, or to restore the disintegrated concrete to its original contours.

It is not necessary to prepare forms for the repair operation, since the original concrete will serve as a shield against which the gunite is shot. The finished surfaces are true, with sharp, well-defined corners and angles. Any finish required can be employed. It is recommended, however, that the finish be the natural cement gun finish as applied by the nozzle.

Average characteristics of the "gunite" mixture indicate compressive strength running as high as 10,000 lbs. per sq. in. in 30 days, modulus of elasticity exceeding 4,000,000 lbs. per sq. in., no sand, air and water pockets when placed at from 40 to 60 psi. pressure. The material has 5% moisture absorption or less, is exceptionally dense and waterproof, will bond to any clean surface and in laboratory tests between concrete and gunite blocks, failed either in the concrete or in the concrete-gunite joint at an average of 213 lbs. per sq. in. — J. Q. A. Greene, Gunite Concrete & Construction Co., Kansas City.

What has been learned from the study of corrosion of condensate well casing, fittings and flow lines sponsored by N.G.A.A. that will help a cycling or natural gasoline plant operator in combatting his own plant corrosion problems?

The N.G.A.A. Corrosion Research Project Committee work has indicated several things which will be helpful to cycling and natural gasoline plant operators in combatting and studying his own plant corrosion problems. One

of these is the use of metal test coupons to determine corrosion rates. These may be used in pressure lines and vessels in the plant, similarly to the use they have been put to in the corrosive distillate wells in the field. They may also be used, and in fact are being used, in cooling towers to study the corrosive effects of the circulating water.

The effectiveness of sodium dichromate in low concentrations in the absence of oxygen has been brought out by the N.G.A.A. work. Therefore, in some instances it is conceivable that the plant operator might economically use chromate in low concentrations to reduce internal corrosion in parts of his plant system that are known to be free of oxygen.

The N.G.A.A. work also has indicated the importance of considering acidity produced in the liquid water phase by carbon dioxide. Therefore, where the plant operator is handling carbon dioxide under reasonably high partial pressures, he is forewarned by the N.G.A.A. work to anticipate the possibility of corrosion of iron equipment.

The plant operator will be interested in N.G.A.A. and National Assn. of Corrosion Engineers results on the use of low chrome and low nickel alloys in the field. If these alloys continue to indicate the excellent corrosion resistance that present field tests indicate, the use of such alloys in corrosive areas in the plant would appear to be well worth further investigation.

The N.G.A.A. group also has sponsored research work at the Corrosion Research Center of the University of Texas. This group has acquired familiarity with the practical operating problems of the natural gasoline and cycling industries to some degree and is well qualified to discuss with any gasoline or cycling plant operator his peculiar corrosion problem. This group is available on a consultation basis for any specific corrosion problems that may arise in gasoline or cycling plants.

The above opinions are not necessarily those held by Lone Star Producing Co.—T. S. Bacon, Lone Star Producing Co., Dallas (former chairman, N.G.A.A. Corrosion Research Project Committee).

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Using present conventional methods, what is the maximum economic propane recovery in the stock tanks for a natural gasoline plant, and what procedure is recommended? Assume the wet gas has 5 mol-% propane, 10 mol-% butane and heavier, and plant intake pressure is (a) less than 250 psi. and (b) more than 250 psi.

Five factors in general determine the propane recovery which may be economically practical for any given natural gasoline plant (assuming propane to be worth on the order of 5c per gal). Many other minor factors should also be taken into consideration, but these can be best considered as part of studies of individual plants. The principal factors are:

1—Whether plant is presently in operation or whether the plant under consideration is being designed for installation. If the plant is already in operation, application of refrigeration to gas and oil entering the absorber and also the use of refrigeration for sub-cooling distillation unit overhead and de-ethanizer overhead will be found useful. It is quite costly to increase oil circulation through a plant already in operation. Therefore, propane recovery that can be attained by use of refrigeration is commonly considered the economic point to approach. In large plants a considerable rebuild, including additions to oil circulation, may be justified.

2—Assuming the plant in question is being presently designed, so process engineers have a free hand, the first consideration in trying to arrive at economic propane recovery is the size—capacity—of the plant itself. If a plant is relatively small on the order of 20,000 gal. per day of absorption gasoline, butanes and propane, it is obvious that the economic propane recovery point will be lower percentagewise than for a large plant, say producing 200,000 gal. per day of total products.

3—Location of the plant has a considerable bearing on maximum economic propane recovery. This is particularly true in the case of small plants. If a lively local market is available, even a small plant can go for relatively high propane recovery; but if the product must be marketed in tank cars to a distant point, the small plant may be at a disadvantage.

4—Pressure at which gas to the plant is available for absorption has much to do with the economic propane recovery limit. If absorption pressure is at 100 psi., propane recovery above 25% is rarely feasible. If pressure is available around 250 psi., 50% propane recovery would be a fair assumption. If 600 lbs. pressure is available, propane recoveries as high as 75 to 85% can be justified if other conditions are right.

The foregoing statements assume cases where the absorption pressure is available because the gas is marketed at predetermined pressures or for other reasons aside from gasoline plant operation. If the gas comes to the plant at low pressure and the only reason for increasing this pressure is to improve recovery from gasoline plant, then a case study should be made to determine the optimum pressure at which to operate compressors as part of determining economics of propane recovery. The ideal pressure range of absorbers for propane recovery is from 500 to 700 psi.

5—The biggest single factor controlling economics of propane recovery is the concentration of propane in the gas itself. If it is relatively lean, meaning 2 to 4% propane in gas coming to the plant, propane recovery above 30 or 35% probably will not be economically feasible. If the propane content is in the medium range, say 4 to 7%, 50 to 60% might be considered a reasonable assumption. If the gas is rich in propane, 10 to 14% propane content, recoveries as high as 85 to 90% are considered economical.

It is obvious that all of the factors mentioned above must be taken into account since each factor affects the others. No overall conclusions can be stated categorically. It can be stated factually that at the present time one particular plant having propane content in gas of about 7 mol-% is being designed for 75% propane recovery. Approximately 100,000,000 cu. ft. of gas is available and absorption pressure is set at 600 psi. because this is the pressure required for marketing the gas. This plant is a combination oil absorption and refrigeration unit.

It can be further stated that in another plant having approximately 50,000,000 cu. ft. of gas available, the gas containing 12 to 14 mol-% propane, the absorption pressure is set at 700 psi. and the recovery at 85% of propane. This plant is a straight oil absorption unit.

The present overall situation is that propane recoveries are trending upward because the market is strong. Each plant situation should be studied so that design percentage of propane recovery can be intelligently set.—R. P. Mase, Jones & Laughlin Supply Co., Engineering & Construction Division, Tulsa.

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Top: One of the specially-trained members of the Du Pont medical staff and a safety service representative discussing regulations governing the handling of TEL compounds with a refinery superintendent responsible for blending of gasoline.

Bottom: View in chemical section of a district laboratory. All district laboratories are also equipped with a knock testing section for making octane determinations.

Right: A Du Pont safety service representative training new blending plant operator in TEL tank car unloading procedure.

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RAPID METHODS OF ANALYSIS

Most refinery laboratories at one time or another have occasion to develop their own individual short-cut analytical methods. Many of these procedures are equally as good as the conventional ones in certain applications, and frequently have the added advantage of being more easily and rapidly performed. To make these improved procedures more widely available to the industry in general, a "Symposium on Rapid Methods of Analysis" was held by the Division of Refining during the API's 28th annual meeting in Chicago, Nov. 8-11. Fifteen papers describing such methods were presented. Below are given brief abstracts of each of them. For complete copies of any of the papers, it is suggested that readers write the API, 50 West 50th St., New York 20.

Sulfur in Hydrocarbons

"Quantitative Determination of Sulfur in Hydrocarbons by X-Ray Absorption," by William L. Kehl and John C. Hart, Gulf Research and Development Co., Pittsburgh, Pa.

A rapid method has been developed for quantitatively determining the sulfur content of liquid hydrocarbons which contain essentially only sulfur as impurity. A North American Philips Geiger counter X-ray spectrometer unit has been adapted for this purpose. The Geiger tube, scaling circuit, and mechanical counter are used to measure the intensity of the beam transmitted by the unknown and by a standard absorber. A suitable calibration curve relates the sulfur content of the unknown, in per cent by weight, to the observed intensities. This method enables a technician easily to analyze a sample in 10 min, and the analyses have been found to be accurate to within $\pm 0.025\%$ by weight for samples containing from 0 to approximately 3% by weight of sulfur.

Stack-Gas Analysis

"Rapid Method of Stack-Gas Analysis for Total Sulfur and Sulfur Dioxide," by C. W. Key, Richfield Oil Corp., Wilmington, Calif.

The current interest and regulations of the petroleum industry in "air pollution" necessitates a rapid analytical method by which the total sulfur and the sulfur-dioxide content of stack gases may be determined. To be of greatest utility the method of sampling and analysis should be accurate, rapid, and simple to manipulate. These requirements have been accomplished in a procedure by which the total sulfur content of stack gases is determined by oxidation and simultaneous absorption of the sulfur dioxide and coexisting sulfur trioxide in a 3%-aqueous solution of hydrogen peroxide. The per cent of sulfur as sulfur dioxide is determined separately by mass spectrometer.

The sampling techniques, analytical apparatus, and procedures are described. Also included are summaries and tabulations of results obtained on stack gases from a miniature stack prepared in the laboratory, synthetic blends of sulfur dioxide and air, as well as typical results obtained on commercial-unit flue gases. The results obtained both by the hydrogen-peroxide and mass-spectrometer methods show good agreement between those by actual analysis and the theoretical. The method is rapid and accurate, thus providing a means of checking the sulfur content of refinery flue gases.

Stripper Efficiency

"Carbon Dioxide Scrubbing Method for Determining Stripper Efficiency," by L. A. Webber, Phillips Petroleum Co., Borger, Texas.

The degree of solvent stripping is an important factor in the efficiency of gas-absorption processes, and is of major importance in processes requiring high solvent-to-feed ratios. A carbon-dioxide scrubbing method has been developed which is superior in accuracy to the distillation and vapor-pressure procedures for evaluating stripper efficiency and which has also additional advantages of requiring less analytical time and skill.

The method was developed specifically for the analysis of residual C_4 hydrocarbons in denuded furfural solvent used in butylene purification, but has been applied with equal precision in the analysis of denuded mineral seal oil used in conventional oil-absorption processes. Although the method has been used as a control analysis only for residual C_4's, slight modifications have been investigated which indicate that the method should have utility in measuring the stripping efficiency of natural gasoline and vapor-recovery absorption systems.

Carbon Monoxide, Carbon Dioxide

"Continuous Determination of Carbon Monoxide and Carbon Dioxide in Pilot Plant and Refinery Operations Using an Infrared Gas Analyzer," by H. Sobcov and F. P. Hochgesang, Socony-Vacuum Laboratories, Paulsboro, N. J.

Within the past few years simple and rugged infrared instruments, based upon an infrared filtering system somewhat similar to a visible light colorimeter, have been devised and used by several investigators to analyze continuously samples and, in some cases, process streams. This paper reports the application of such an instrument to the continuous determination of carbon monoxide and carbon dioxide in the flue gases from certain catalytic cracking operations. A commercial infrared gas analyzer has been sensitized, calibrated, and tested in the laboratory; then field-tested under normal plant operating conditions to determine: (1) carbon monoxide in the flue gas from an experimental TCC catalyst regenerating kiln; and (2) carbon monoxide and carbon dioxide, individually, in the flue gas from a full-scale Houdry catalytic cracking unit. During several months of field testing this instrument was found to perform the foregoing analyses continuously, re-

liably, and with little maintenance, thereby aiding in operational control and efficiency calculations for these plants. A brief description of the principle of, and procedures for, operation of the instrument is given. The infrared analyzer is believed to offer distinct advantages over other types of instruments currently in use.

Dissolved Oxygen In Hydrocarbon Oils

"Determination of Dissolved Oxygen (in Hydrocarbon Oils)," by J. H. D. Hooper, Anglo-Iranian Oil Co., Ltd., Sunbury-on-Thames, Middlesex, England.

As part of a program concerned with the solvent refining of lubricating oils, a method has been developed for determining the dissolved-gas and oxygen contents of oil samples. This method has been applied particularly to lubricating-oil components and also to furfural, but it can be used for determining dissolved oxygen in the majority of liquid petroleum products, including volatile liquids such as gasoline.

The procedure, which is suitable for routine use, involves the removal of dissolved gas from a known weight of oil sample by agitation under reduced pressure in a special degassing vessel. Oils are normally degassed at 100° C.; but for liquids with relatively low boiling points, such as furfural, the determination is made at room temperature. The extracted gas is measured in a burette and then transferred to a Haldane apparatus for the determination of oxygen content.

The test requires between 50 ml. and 150 ml. of sample; and a complete determination can be carried out in from 2 to 4 hrs., depending upon the viscosity of the sample.

The accuracy of the method has been checked by using the apparatus to determine the solubility of oxygen in distilled water, when consistent results in close agreement with the known value were obtained. The apparatus and test procedure are described in detail, and various possible sources of error, including those incurred during sampling, are discussed.

Burners for Elemental Analysis

"Modified Burners for Elemental Analysis by Lamp Combustion and their Application to Special Problems," by G. E. C. Wear and E. R. Quiram, Esso Laboratories-Research Division, Standard Oil Development Co., Elizabeth, N. J.

This paper describes several modified burners which are superior to the standard burner for lamp combustion specified in ASTM Test D 90-47T. Burners for both volatile and non-volatile liquids have been designed and are illustrated. Application of these modified burners to the following problems is discussed:

1. Determination of sulfur in aromatics without recourse to blending.
2. Determination of halogens (chlorine and bromine) in gasoline: Essentially complete combustion is obtained as contrasted to results 10 to 30% low using the standard burner.
3. Determination of carbon and hydrogen in petroleum hydrocarbons: Although satisfactory results for hydrogen only may be obtained with the ASTM burner, it is known to yield low results for carbon.

Plant Viscosity Control

"Use of the Viscorator for Plant Viscosity Control," by A. E. Franzen, Standard Oil Co. (Ind.), Whiting, Ind.

A continuous viscosimeter, manufactured under the trade name of "Viscorator," has been found to be suitable for viscosity control of motor-oil distillates. With this manually-operated indicating instrument, an accuracy of ±3 sec. Saybolt Universal viscosity can be expected. Some operating difficulties, such as flow pulsation and time lag for true temperature, were encountered. Continuous recording Viscorators, with proper auxiliary flow and temperature controllers, are expected to eliminate these operating difficulties and thereby increase the accuracy.

Naphthalene, Methyl Naphthalenes And Total Naphthalenes

"Determination of Naphthalene, Methyl Naphthalenes, and Total Naphthalenes in Admixture with Other Hydrocarbons by Ultraviolet Absorption," by J. A. Anderson, Jr., Humble Oil and Refining Co., Baytown, Texas.

A method utilizing ultraviolet absorption spectroscopy has been developed whereby analysis of the 100- to 480° F. fraction of petroleum for naphthalene (boiling point = 424° F.), alpha methyl naphthalene (boiling point = 473° F.), and beta methyl naphthalene (boiling point = 466° F.) can be made in 1 to 1½ hrs. An approximate analysis for total naphthalenes in fractions having a maximum boiling point of 550° F. can be made in about 30 min. In the determination of individual naphthalenes in samples having a maximum boiling point of 480° F., absorption measurements are made at 9 wave lengths. Base-line absorption coefficients are obtained at 3 points, and simultaneous equations are solved for determination of the percentages of naphthalene, alpha methyl naphthalene, and beta methyl naphthalene. The approximate analysis is made for total naphthalenes on the basis of absorption measurements at two wave lengths. In the case of samples having a maximum boiling point of 550° F., analysis is made for total naphthalenes only, using absorption measurements at 2 wave lengths. Several hundred samples have been analyzed by this procedure. Results on synthetic samples have indicated that a precision of about 1% of a naphthalenic component on a total sample basis can be obtained. Routine samples may contain interfering components which will cause the absolute accuracy of analysis to be somewhat less than that obtained in the analysis of synthetic samples. However, in the numerous routine samples which have been analyzed, good agreement (± 2 to 3%) has been obtained for the total naphthalenes present as indicated by the sum of the individual components and by the analysis for total naphthalenes.

Inorganic Chlorides in Crude Oil

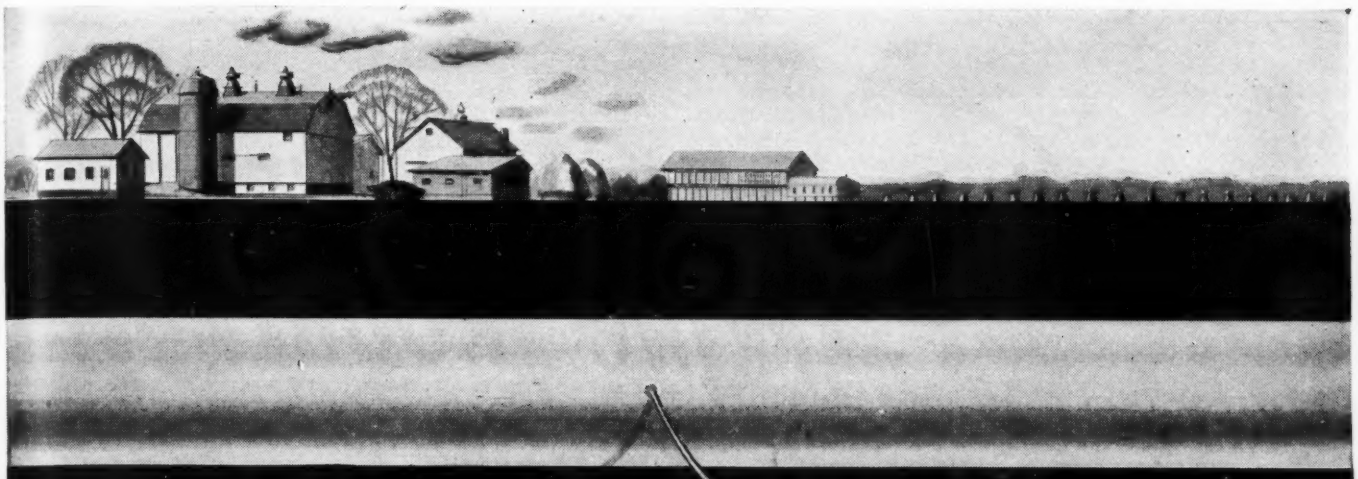
"Determination of Inorganic Chlorides in Crude Oils by Direct Electrometric Titration," by R. E. Dickey and L. V. Sorg, Standard Oil Co., (Ind.), Sugar Creek, Mo.

Existing methods for the routine determination of inorganic chlorides in crude oil are similar, for the reason that it is necessary first to extract the chlorides with water and then to determine the chlorides in the aqueous extract. These methods are time-consuming, and difficulty is encountered in obtaining consistently reproducible results, particularly between different laboratories.

A procedure has been developed by which it is possible to titrate directly the inorganic chlorides in crude oil without preliminary water extraction. This procedure utilizes the precision-shell titrometer to carry out a direct electrometric titration in a non-aqueous solvent. A silver electrode is used as the indicating electrode, and a high-resistance glass electrode as the reference electrode—the titrating solution being standard silver nitrate in 90% isopropyl alcohol.

A wide variety of crude oils from various producing fields has been analyzed for inorganic chlorides, and the direct electrometric titration method has been found applicable in all cases. The presence of hydrogen sulfide and/or moderate amounts of mercaptans does not impair the precision of the method.

The precision and accuracy of direct electrometric titration have been shown to be adequate for control purposes. For crude oils containing inorganic chlorides equivalent to 0 lb. to 300 lb. sodium chloride per 1000



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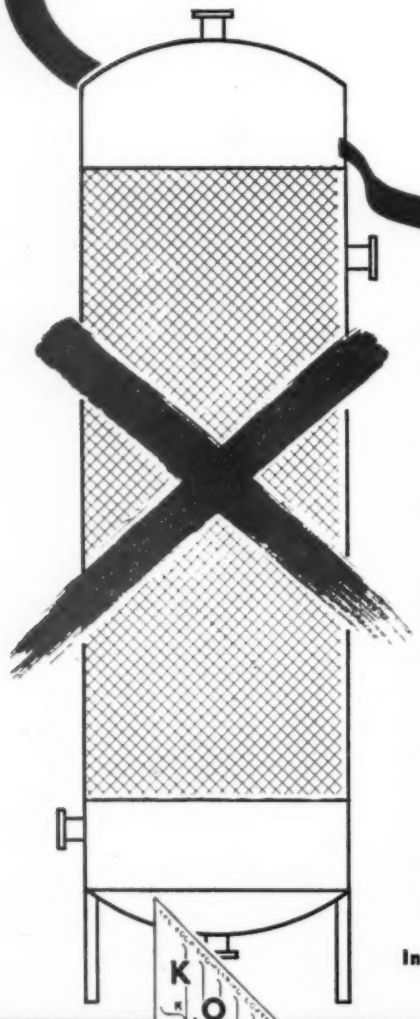

It is well known that packed towers are poor devices for liquid-liquid contacting due to their excessive tendency toward channeling.

Tests have shown that Koch Kaskade trays give twice the efficiency and twice the capacity of rings or bubble trays in caustic scrubbing of gasoline.

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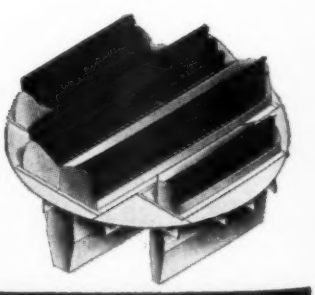

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U. S. PATENT NO. 2,401,569

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KOCH KASKADE

THE KOCH ENGINEERING COMPANY

CONSULTING and CONTRACTING ENGINEERS

335 West Lewis St. Wichita, Kansas

British Associates: Messrs. A. F. Craig & Company, Ltd., Paisley, Scotland

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Nitrogen in Volatile Organic Compounds

"Determination of Nitrogen in Volatile Organic Compounds by a Semimicro-Dumas Method," by B. B. Buchanan, M. D. Grimes, D. E. Smith, and B. J. Heinrich, Phillips Petroleum Co., Bartlesville, Okla.

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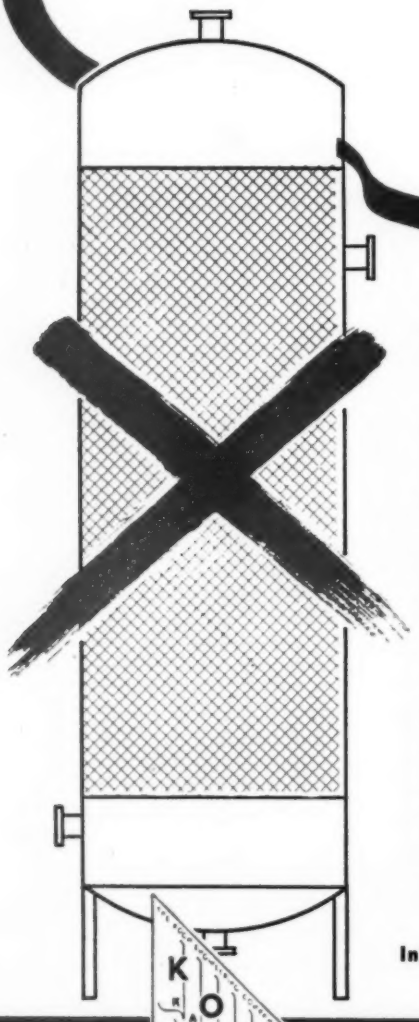

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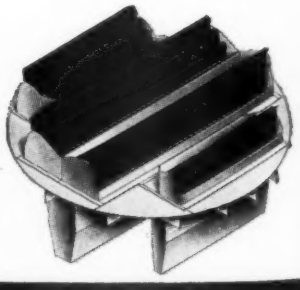

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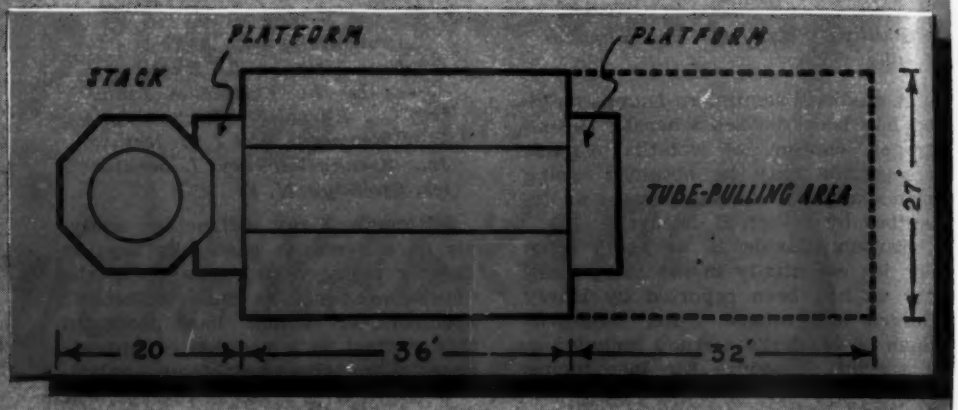
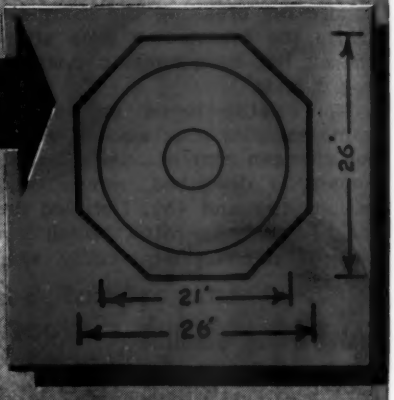
Ground space plan for average box-type furnace of 50 million BTU/hr capacity



THE SAVING IN GROUND SPACE IS OBVIOUS!

Ground space plan for average Petro-Chem Iso-Flow Furnace of 50 million BTU/hr capacity



Did you ever try to cramp additional equipment into the confines of an existing refinery, or plan the layout of equipment for a new plant . . . if you did, you know the importance of every square foot of ground space.

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Petro-Chem Iso-Flow Furnaces require a minimum of ground space and are unlimited in size, capacity and duty.

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Gas-Freeing Tanks—Air vs. Steam

The following article is a digest of the paper "Safe Handling of Petroleum Products; Gas-Freeing Tanks—Air Movers vs. Steaming," by R. W. Black, chief safety engineer, Esso Standard Oil Co., Elizabeth, N. J., prepared for presentation to a group session on Accident Prevention during the 28th Annual Meeting of the American Petroleum Institute in Chicago, Nov. 8-11, 1948.

STORAGE tanks can usually be gas-freed with greater safety, in a shorter time, and at a lower cost by air-purging rather than by the commonly practiced method of steaming, according to R. W. Black, chief safety engineer of Esso Standard Oil Co.

As a result of a study made of recent tank fires which have occurred during gas-freeing operations, it was concluded that methods of gas-freeing tanks with the use of steam are costly, slow, and, under certain conditions, hazardous, Mr. Black reported to a group session on Accident Prevention at the API's annual meeting in Chicago, Nov. 8-11.

"Our methods of gas-freeing tanks in the past have been influenced in much too large a degree by the utilities available for the gas-freeing operation," he stated, "without sufficient consideration being given to factors of safety, economy and efficiency.

"At refineries, steam has usually been available in the tank field and, as a result, the steaming method for gas-freeing tanks was quite simple, and largely was followed for this reason alone. Consideration was rarely, if ever, given to the cost of the steam and the question as to whether some other method might not perform the job more quickly, with a greater degree of safety and at lower cost."

Based on the studies, which included API reports of tank explosions and a memorandum on tank ventilation by O. W. Johnson of Standard Oil Co. of California, Mr. Black presented a group of recommended procedures for gas-freeing various tanks.

"It is intended," he cautioned, "that these procedures be used only as a guide in preparing a specific set of local procedures covering the various types of gas-freeing operations. It is recognized that all refineries do not have identical problems because of weather, variation in equipment, stocks, etc. Therefore, different methods may have to be followed to accomplish the same results. It is further recognized that water and power are available only in limited quantities in our marketing departments. Therefore, their procedures call for different methods and equipment."

Included in his report were procedures for both cone-roof type and floating-roof type tanks, with varying procedures for tanks which had contained either finished gasoline and other similar products, sweet crude, sour crude, or sour distillate. Also included was a procedure for ventilating high-flash (100° F.+) sweet stock tanks.

In general, Mr. Black made the following recommendations:

1) There is no single best method for conducting all tank gas-freeing operations.

2) Establish a local step-by-step procedure for each similar tank-purging operation.

3) Consider carefully the problems presented by the stock previously stored in the tank, such as sour oils, aromatic stocks, leaded gasolines, acids, caustics, etc.

4) Provide appropriate equipment to conduct the gas-freeing operation at a rapid rate.

5) Keep men away from the tank, and work in the immediate vicinity of the tank should be kept to a minimum while the tank is being air-purged.

6) If it is necessary to use steam for tank-purging, conduct the steaming operation at as high a rate as possible consistent with not overpressuring the tank.

A typical example of the procedures recommended is given in the box below.

Procedure for Gas-Freeing Sour Distillate, Floating-Roof Tanks

(*Note: The Rules for Handling Sour Crudes and Distillates* shall be complied with until the tank is clean and tests free of hydrogen sulfide.)

1) Before roof rests on its legs, place fog nozzle at top platform and discharge water fog downward to wet inside of tank shell during last stage of pumpout.

2) Pump out all possible product through existing lines.

3) Introduce water to float remaining product, and pump product out.

4) Blank all lines except foam and water drawoff.

5) Lay water-fog lines, establish flow through fog nozzles. Remove one or more side manhole plates, and immediately insert a fog nozzle in each open manhole.

6) Continue application of water fog for a minimum of one hour and until gas tests less than 50% of the lower explosive limit.

7) Continue application of water fog, and begin breaking up water and sediment with grounded-nozzle high-pressure hose stream through opposite side manhole. Inasmuch as this operation may release gases, continue tests for hydrogen sulfide and gas. Pump or syphon sour water and water and sediment to sewer through manhole. Notify separator personnel of sour water in sewer.

8) Comply with *Rules for Handling Sour Crudes and Distillates* when entering tank for cleaning purposes.

9) Men may enter the tank without gas masks and perform cold work when the following are complied with:

a) Tank is clean.

b) Tank is free of hydrogen sulfide.

c) Gas concentration is less than 20% of the lower explosive limit.

d) All lines are blanked.

10) Before hot-work permit is issued, the tank shall test gas-free and be free of oil.

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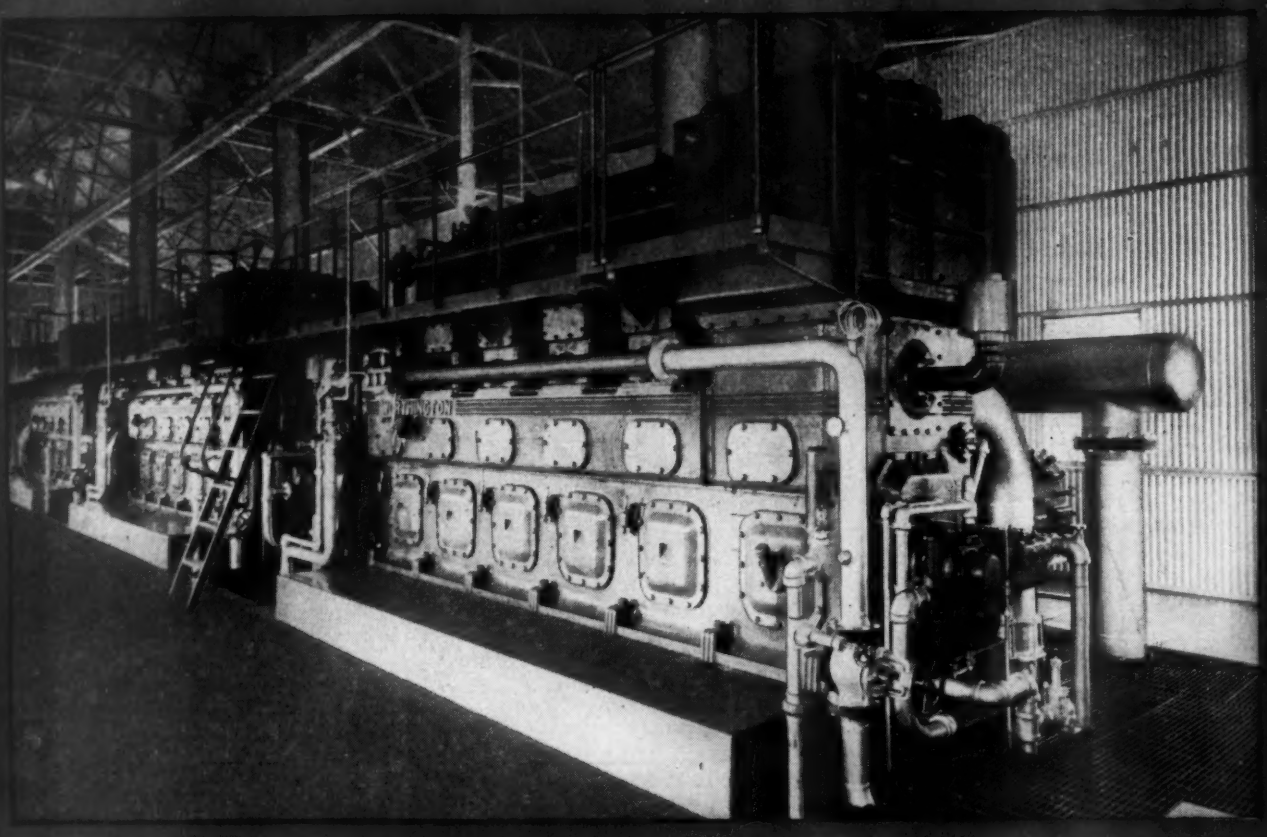
WORTHINGTON ANGLE ENGINE COMPRESSORS



A Battery of Worthington Angle Gas Engine Compressors — Type LTC, 600 hp — in the Halliday, Texas, Plant of Warren Petroleum Company

In these views of Worthington LTC Angle Engine Compressors, note the size and number of covers on both main and compressor frames.

Thanks to this greatly increased accessibility, the work of maintenance crews is so simplified that keeping efficiency at peak is reduced to an easy, effortless routine.

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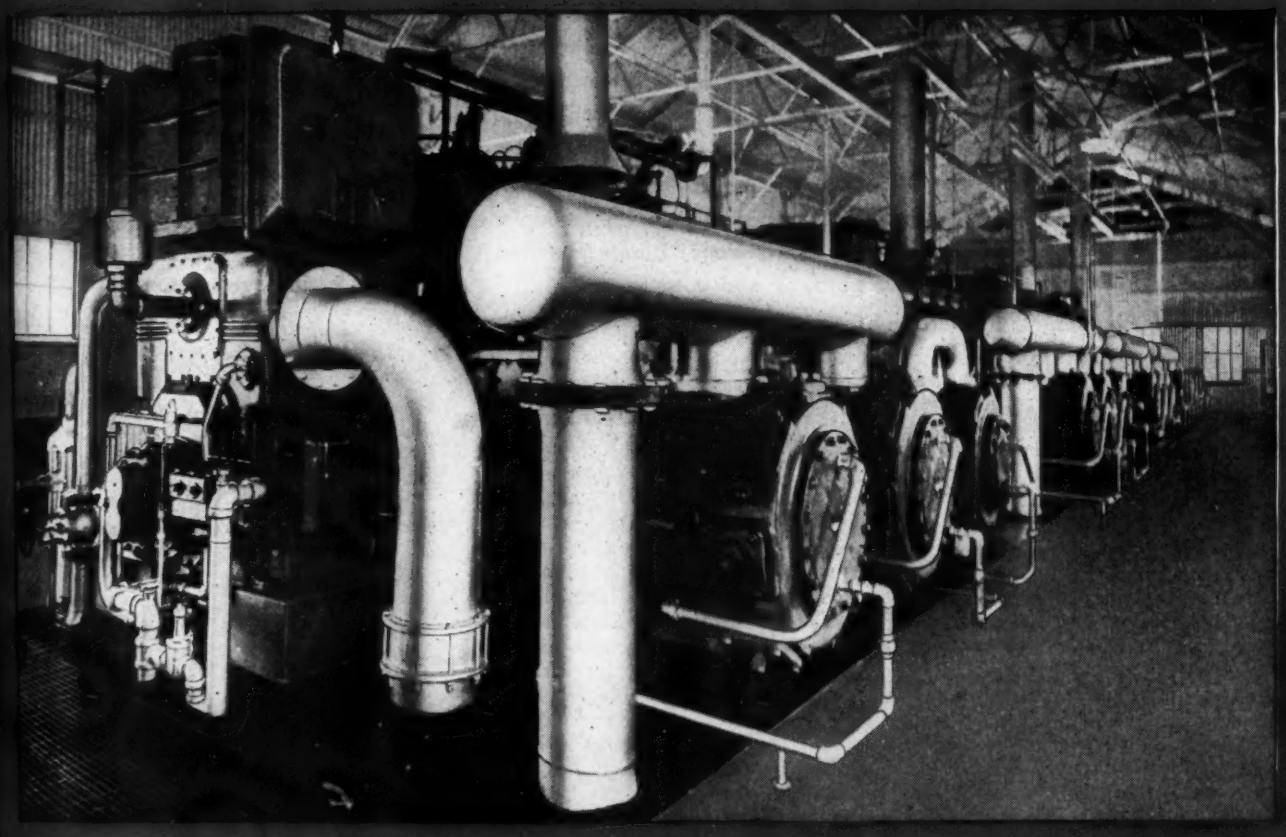

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Propane Recovery by Absorption

By LUDWIG KNIEL,
The Lummus Co., New York

Increased extraction of propane of the required purity in absorption gasoline plants may be achieved through changes in the fractionating absorber and its important adjuncts, the gas cooler and partial condenser. Design formulae are presented for the absorber, for the determination of liquid and vapor traffic, key temperatures and other factors which relate retention in the absorber and rejection in the stripper with overall recovery.

Plant design based on the formulae is applied to the recovery of 90% propane from a wet gas of specified composition, as an example. Product costs are shown lower than in most conventional plants handling an equal volume of gas and recovering gasoline and butanes only.

This paper was presented before the California Natural Gasoline Assn. at Los Angeles, Oct. 8, 1948.

WHEN it is desired to increase propane recovery in an existing absorption plant one of the first measures taken may be the substitution of a lower molecular weight absorption oil which may or may not have the same volatility characteristics. The next step would be to increase the lean oil circulation or to lower the absorber temperature.

Substituting a lower molecular weight lean oil of the same characterization factor, that is, of correspondingly greater volatility, will increase the lean oil loss over the absorber; if an oil having a lower characterization factor but the same volatility is used it probably will be found to be less stable and result in a greater loss of heavy ends over the rerun still. It is then up to the operator to determine where his greatest gain lies. Adequate increases of the lean oil rate often require modifications or additions to existing equipment, and the lowering of the absorber temperature beyond that obtainable with additional lean oil coolers is definitely a major operation.

All of these measures to increase recovery are, however, eventually limited by the capacity of a particular plant to handle and to efficiently eliminate the larger volumes of ethane and methane which attend the removal of an increased proportion of the propane with the lean oil. The objective obviously is to obtain the extra recovery of the desirable constituent undiluted as much as possible by the more volatile undesirable constituent. To attain this objective it is necessary to carry out a more efficient fractionation at the primary point of contact between oil and gas, which is in the absorber itself.

The fractionating absorber as it is commonly called performs this duty. A gas cooler and partial condenser is an important adjunct of the absorber. It is equipped with a reboiler at the base of the stripper and with one or more inter-coolers at proper points in the absorber.

In the absorption section the less volatile fractions of the wet gas and of the vapors leaving the stripping section are absorbed and reabsorbed, respectively, according to well-known laws in a descending stream of the lean oil. In the stripping section the undesirable more volatile fractions are driven off through the application of heat to the reboiler and are returned to the absorption section.

A recycle stream between the absorption and stripping sections is thus created and it is this stream which acts as the vehicle for the better separation between the key components. The action of the fractionating absorber may be better understood with the help of a few simple formulae which relate retention in the absorption section and rejection in the stripping section with overall recovery.

Let it be assumed that V mols of vapors and L mols of condensate enter the absorber above the top deck of the stripping section. L_0 mols of a non-volatile lean oil enter at the top of the absorption section, Y mols of vapor leave the stripping section, X mols of downflow of absorbed fractions leave the absorption section. D mols and B mols leave as off-gas and in the fat oil, respectively. Let α be the mol fraction of any component retained in the oil from the absorption section and let β be the mol fraction of any component rejected from the stripping section. Then, irrespective of the amount of oil circulated, one has as a material balance over the entire column:

$$F = V + L = B + D$$

for the absorption section:

$$\alpha\,(V + Y) = X \quad \ldots\ldots (1)$$

and for the stripping section:

$$\beta\,(L + X) = Y \quad \ldots\ldots (2)$$

Also:

$$(1 - \alpha)\,(V + Y) = D \quad \ldots\ldots (3)$$

$$(1 - \beta)\,(L + X) = B \quad \ldots\ldots (4)$$

By eliminating Y from (1) and (2):

$$X = \frac{X + \beta L}{(1/\alpha) - \beta} \quad \ldots\ldots (5)$$

and by eliminating X, similarly:

$$Y = \frac{\alpha V + L}{(1/\beta) - \alpha} \quad \ldots\ldots (6)$$

from (3), by substituting (6):

$$D \equiv D_1 + D_2 = \frac{1 - \alpha}{1 - \alpha\beta}(V + \beta L) \quad \ldots (7)$$

where:

$$D_1 = \frac{1 - \alpha}{1 - \alpha\beta} V$$

or:

$$D_1/V = \frac{1 - \alpha}{1 - \alpha\beta} \equiv f_1\,(\alpha, \beta) \quad \ldots (8)$$

and:

$$D_2 = \frac{1 - \alpha}{1 - \alpha\beta} \beta L,$$

or:

$$D_2/L = \frac{1 - \alpha}{1 - \alpha\beta} \beta \equiv f_2\,(\alpha, \beta) \quad \ldots\ldots (9)$$

D_1 is obviously the fraction of any component in the vapor feed which is lost and D_2 is the fraction of any component in the liquid feed which is lost in the off-gas. The expressions $1 - f_1\,(\alpha, \beta)$ and $1 - f_2\,(\alpha, \beta)$ thus represent the fractions which are recovered. For $\beta = 0$, which indicates no stripping, D_1/V becomes $1 - \alpha$ and $D_2/L = 0$. For the same degree of retention, α, the recovery decreases with an increase in the value of β, the degree of stripping, as the denominator $1 - \alpha\beta$ becomes gradually smaller. But the amount by which the loss of D_1 increases with an increase in β for constant α varies with α and β.

This relationship is shown graphically in Fig. 1 where α and β are plotted to a logarithmic scale. For zero stripping the values of $1 - f_1$ are of course equal to α and for a sufficient number of plates, so that linearity exists between α and the absorption factor A, they are also equal to A. The curves f_1 = constant show how α must be increased with an increase in β to obtain the same degree of recovery. Fig. 2 shows the degree of recovery $1 - f_2$ of the condensate entering the stripper. The loss f_2 is β times the corresponding loss of any constituent in the vapor feed. Without reabsorption, i.e. with $\alpha = 0$, the loss is β times the mols of a constituent in the liquid feed.

As an example, consider the sepa-

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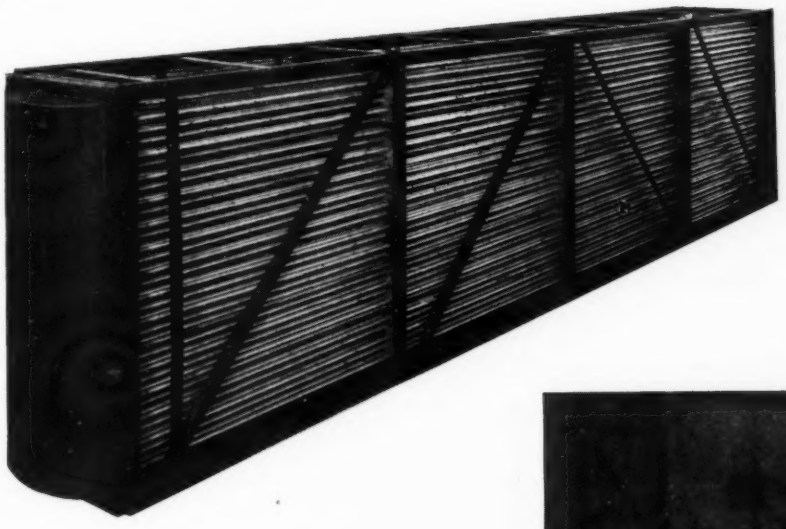

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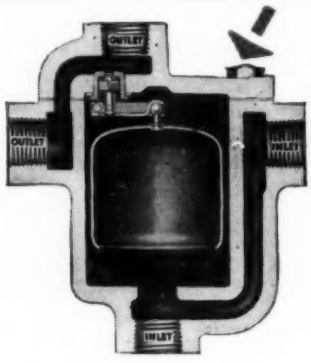

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TABLE 1—Composition of Pyrolysis Gas

Component	Mol-%
Hydrogen	10
Methane	25
Ethylene	25
Ethane	4
Propylene	17
Propane	16
Heavier	3

ration of methane from ethylene in the pyrolysis gas of Table 1, obtained from the cracking of propane.

Assume that the charge is all vapor and the absorber is operated at 450 psig and 60° F., with an effective ethylene factor of 0.93. Without benefit of stripping there would be 22.5 mols of ethylene and 6.9 mols of methane recovered. The maximum ethylene purity obtainable, which is set by the amount of methane dissolved in the lean oil, would be approximately 77 mol %. Table 2 shows the results obtained with various degrees of stripping.

With moderate stripping, β (methane) = 0.5, the ethylene recovery would decrease to 88% and the methane content of the ethylene product would decrease to approximately 15 mol. %. With severe stripping, β (methane) = 0.9, the purity would be increased to 96 mol % while the recovery would drop further to 86%.

These figures assume that the absorption factor is maintained by increasing the lean oil rate very nearly in proportion to the total volume of vapors entering. Actually both absorption and stripping rates may be varied within relatively wide limits to obtain satisfactory recovery and purity.

The same results may be read off directly from Fig. 1 where point "*a*" represents the α, β coordinates of ethylene and point "*c*" those of methane. The distance *a-b* is equal to the ratio of the α values and *b-c* equals the ratio of the β values. When $\alpha = A$ and $\beta = S$, which assuming 12 theoretical plates is true for values of A and S of less than 0.8 the distances *a-b* and *b-c* are also equal to the ratios of the effective absorption and stripping factors or inversely proportional to the ratios of the equilibrium constants.

After establishing the α and β values for the key and all other components from the well-known graph of recovery vs. absorption factor,

$$\frac{Y_{n+1} - Y_1}{Y_{n+1} - Y_0} = \frac{A_e^{n+1} - A_e}{A_e^{n+1} - 1}$$

and calculating the losses D by means of Equation 6, one obtains the total vapor flow $V + Y$ and, by difference, $L + X$, the total downflow to the stripping section.

Knowing the effective absorber and stripper temperatures from experience the lean oil rate then may be estimated either from the absorption or stripping factor by means of Edmister's[1] formulae as that value of L_0 which yields the required α and β.

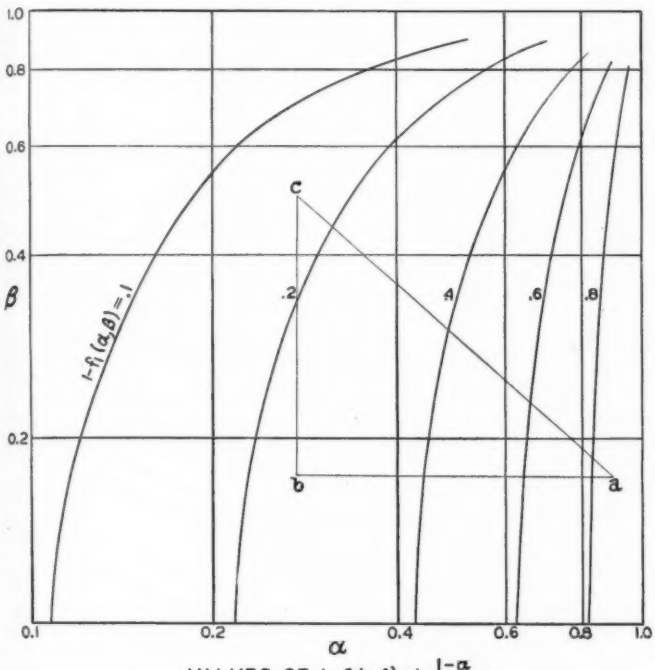

Figure 1

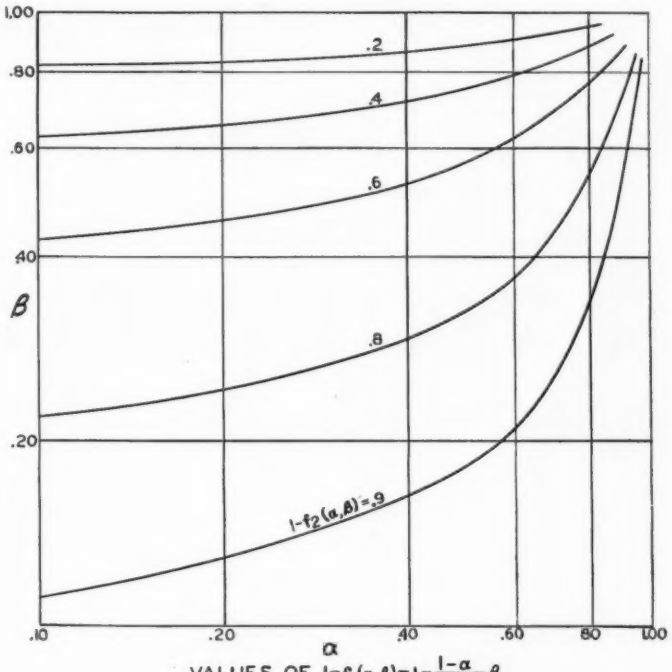

Figure 2

Both values of L_0 should be identical. If they do not coincide, which is to be expected after only one trial, it is very likely that the estimated temperatures are in error.

The bottom absorber plate temperature and the top stripper plate temperature may be checked as dew and bubble points of Y and $X + L_0$, respectively, but these checks are very sensitive to small amounts of the heavy and light constituents included in Y and $X + L_0$ and the results must be interpreted with discretion. Nevertheless, it is not difficult for the designer of some experience to establish whether to increase or decrease the absorber and stripper temperature before he proceeds with a second calculation. Both temperatures have an effect upon the relative α and β; that is, upon the direction of the line a-c above, and small changes in α and β in the range where α or β is greater than 0.9 will cause noticeable changes in the lean oil rate.

This procedure holds rigorously only if the absorption oil contains no volatile constituents but may be used with sufficient accuracy in the absorption of natural gasoline if the lightest fractions of the lean oil and the heaviest fractions of the wet gas do not overlap. If the absorption oil has a volatility comparable to that of the recovered fractions of the wet gas the recycle vapor Y will contain a considerable volume of lean oil fractions and it will be impossible to establish the loss D and downflow X as explained above.

It is necessary in this case to calculate the lean oil requirement in some preliminary way and estimate the amount of stripping experienced by the lean oil on its descent in the absorption section. For the stripping section the lean oil then may be considered a part of L, the liquid feed from the partial condenser. The calculation of Y and of D follows, the latter now containing one additional term due to the presence of volatile lean oil. Equations may be derived for this case which lend themselves to a solution by successive approximations in the same manner as above.

With liquid and vapor traffic and key temperatures known, a heat balance may be drawn up which yields the amount of reboiling and intercooling required. The intercooling load is preferably distributed over several bundles in the absorption section. Internal cooling coils are more advantageous than the common intercoolers since with their use it is possible to realize a uniform temperature gradient rather than the saw tooth profile which is typical of external elements, but often it is not possible to accommodate the necessary surface within the available space. As a final check the L and V values at plates where heat is removed should be estimated and the absorption factor and lean oil rate checked by means of the explicit formulae of Horton and Franklin.[2]

It has been found in plant operations that the performance of fractionating absorbers designed in accordance with this procedure exceeds the requirements anticipated in the design. In one instance, where the design anticipated a 90% recovery of the heavier key in the separation of methane from ethylene, a recovery in excess of 96% with better than design purity was obtained.[3] In another plant, the absorber design called for a 93.5% recovery of the ethylene fraction from a combined stream of pyrolysis gas and thermal and catalytic depropanizer gases containing 19 mol% ethylene, 20.8 mol% methane and 7 mol% hydrogen and contaminants. The residual methane in the ethylene was to be not over 10.3 mol% referred to the recovered mixture of methane and ethylene. Actually the recovery exceeded 96% consistently with a methane contamination of less than 5.0 mol%. Whether this gain in separation efficiency is due to the type of lean oil employed, which contained substantial proportions of aromatics (particularly benzene), or whether it is the result of superimposed recir-

TABLE 2—Effect of Various Stripping Rates

Composition	Charge	K_a	A	α	K_s	S	β	$1-f_1$	B
				β (Methane) = 0					
C_1	25	4.8	.275	.275	...	...	0	.275	6.9
C_{2-}	25	1.42	.93	.90	...	...	0	.90	22.5
				β (Methane) = 0.5					
C_1	25	4.8	.275	.275	7.7	.50	.50	.16	4.0
C_{2-}	25	1.42	.93	.90	2.67	.174	.174	.881	22.04
				β (Methane) = 0.9					
C_1	25	4.8	.275	.275	7.7	.93	.90	.0366	.92
C_{2-}	25	1.42	.93	.90	2.67	.323	.323	.859	21.47

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TABLE 3—Composition of Wet Gas

Component	Mol-%
Methane	80.0
Ethane	6.0
Propane	8.0
Isobutane	1.0
N-Butane	2.5
Pentanes plus	2.5
Component of C_5 Plus	**Vol.-%**
Pentanes	49
Hexanes	23
Heptanes plus	28

TABLE 4—Calculated Recoveries

% Component	Propane Absorber	Butane Absorber	Total
Methane	0.0	0.0	0.0
Ethane	3.53	1.77	5.30
Propane	83.73	6.27	90.0
Isobutane	69.1	29.4	98.5
N-Butane	64.4	34.8	99.2
Pentanes	33.8	66.2	100.0
Hexanes	85.5	13.3	98.8
Heptanes	95.8	—25.3	70.5

culation taking place between the plates where intercoolers are located, has been the subject of speculation. A conclusively satisfactory explanation has not been found.

Plant Design with Absorbers

To demonstrate the value of fractionating absorbers in an installation of importance to the natural gasoline industry it has been applied to the recovery of propane from either a wet or a dry gas. This application has been worked out for a wet gas of the composition shown in Table 3. To fix conditions further it has been assumed that the C_5 plus fraction would have the composition of the corresponding fraction in a typical Kettleman Hills natural gasoline, also shown in Table 3.

The volatility of the pentanes fraction has been taken as that of a mixture composed of two-thirds isopentane and one-third n-pentane. Required is the recovery of 90% of the propane and of practically all of the butanes and heavier. An absorption plant designed to meet these conditions is shown in Fig. 3.

The main features of this design are: use of two fractionating absorbers in series to obtain 90% propane recovery, the propane to be of sufficient purity to pass the LPG vapor pressure specifications (225 psi at 105°F.), and use of the recovered natural gasoline as absorption oil. The wet gas in the present case is being delivered at 150 psig. To obtain economy in initial investment and operating costs the absorber combination must be operated at a pressure upwards of 400 psig and at subatmospheric temperatures. As a fractionating absorber installation does not lend itself to the same degree of heat recovery as is common in a conventional absorption plant it is imperative to hold lean oil circulation to a minimum to save utilities. An absorber pressure of 475 psig and lean oil temperature of 20° F. have been chosen in the present case.

As shown in Fig. 3 the wet gas is compressed in single stage compressors to 500 psig and cooled to 95° F. It is next dehydrated over fixed-bed bauxite driers to forestall the possibility of hydrate formation at temperatures below 60° F., then cooled and partially condensed. It is convenient to cool the wet gas to the temperature of the entering lean oil, in this case 20° F.

The first fractionating absorber—aptly called the propane absorber—is operated with a lean oil rate of 6.3 gals. per 1000 cu. ft. of wet gas and recovers 84% or 220 mols per hour of propane with only 7.0 mols of ethane. The loss of lean oil to off-gas is very high because of its extreme volatility, particularly in the pentane range. Calculated recoveries for the anticipated absorber conditions referred to wet gas quantities have been tabulated in Table 4.

It will be noted in Table 4 that the primary purpose of the second absorber is the recovery of the volatile fraction of the lean oil. Only in a very minor degree does it contribute to an increase in propane recovery.

A detailed analysis shows that to obtain optimum results both absorbers should work in unison in the sense that the load should be borne "equitably" by both. If, for instance, the first absorber recovers more than its share, the imposed stripping load will cause a disproportionate loss of butanes from the lean oil. Recovery of the lost butanes by the second absorber will cause the retention of excess ethane with the result that the LPG product will be off specifications. The opposite extreme would be a condition where the butane absorber has to recover more than its share of propane, which would equally lead to ethane contamination of the LPG product unless absorption and stripping rates were adjusted to correct the condition. Table 5 shows the calculated streams compositions at important stations throughout the plant.

If the lean oil over the butane absorber equals in composition the C_7 and heavier fraction of the gasoline the calculated loss of lean oil will be 8.8 vol % of the yield of 16 RVP natural gasoline, which is 113 gal. per hour or 65 b/d, worth some $200 per day. To view this loss in proper perspective it must be borne in mind, however, that it is constituted of the least desirable fractions in regard to octane number and volatility of the recovered gasoline, and that it represents only 4.4 vol. % of the LPG fraction and only 2.0 vol. % of the total yield of liquid products.

The loss may be decreased at the expense of an increase in oil circulation by using instead of the heptanes plus fraction only the last 15 vol. % or even 10 vol. % of the natural gasoline, as lean oil in the butane absorber. It is necessary to replenish the inventory of lean oil circulating over the butane absorber continuously. This is done by passing an adequate amount of the gasoline over the still which removes the recovered fractions from the butane absorber fat oil. The still overhead which has the composition shown in Table 5 and the propane absorber bottoms are partially debutanized in the debutanizer to leave a 16 RVP gasoline product. The overhead from the debutanizer is then passed to the depropanizer which produces an LPG propane as overhead and excess butanes as bottoms.

Refrigeration is furnished by a conventional compression type refrigeration unit, using LPG-Propane as a refrigerant, at two temperature levels 40° and 10° F., to obtain a minimum cost installation. At the lower

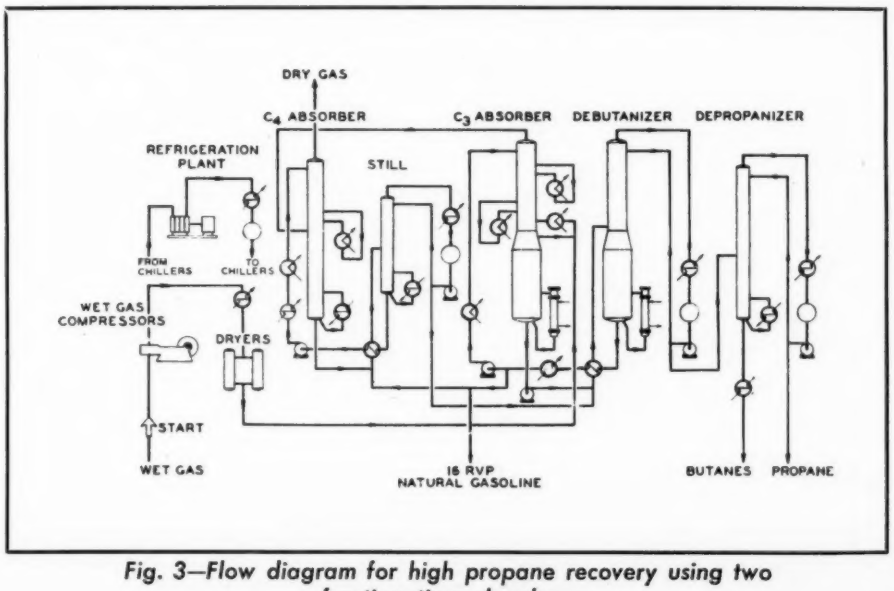

Fig. 3—Flow diagram for high propane recovery using two fractionating absorbers

TABLE 5—Stream Compositions—Mols/Hr

Stream	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Component	Wet Gas	Vapor to Absorber	Liquid to Absorber	C_2 Abs. Off-Gas	Lean Oil to C_2 Abs.	Fat Oil from C_2 Abs.	C_4 Abs. Off-Gas	Lean Oil to C_4 Abs.	Fat Oil from C_4 Abs.	Stripper Makeup	Stripper OH	Debut Feed	16 RVP Nat. Gaso.	LPG	Butanes
Methane	2640	2569.5	70.5	2640	....	....	2640	....	....	....	....	....	....	....	....
Ethane	198	173.5	24.2	191	....	7.0	187.5	....	3.5	....	3.5	10.5	....	10.5	....
Propane	264	182.9	81.1	42.9	....	221.1	26.4	....	16.5	....	16.5	237.6	....	237.1	.5
i-Butane	33	15.8	17.2	10.2	22	44.8	0.5	....	9.7	4.0	13.7	58.5	3.6	1.1	27.8
n-Butane	82.5	32.1	50.4	29.3	88	141.2	0.6	....	28.7	16.0	44.7	185.9	14.4	1.5	66.0
Pentanes	46.2	8.1	38.1	30.6	254	269.6	....	....	30.6	46.2	76.8	346.4	41.6	....	4.6
Hexanes	17.3	.7	16.6	2.5	104	118.8	0.2	3.3	5.6	18.9	21.2	140.0	17.0	....	.1
Heptanes	19.0	.2	18.8	0.8	82	100.2	5.6	326.7	321.9	14.9	10.1	110.3	13.4	....	....
TOTALS	3300.0	2983.1	316.9	2947.3	550	902.7	2860.8	330.0	416.5	100.0	186.5	1089.2	90.0	250.2	99.0
Lbs/hr	73,209	57,815	15,394	54,647	41,812	60,374	49,668	32,954	37,933	7602.0	12,581.0	72,955	6841.0	10,898.0	5802.0
Molecular weight	22.18	19.38	48.57	18.54	76.02	66.88	17.36	99.86	91.07	76.02	67.46	66.98	76.01	43.56	58.60
Gals/hr	....	....	....	....	7884.2	11,917.5	111.5*	5711.8	6754.3	1433.4	2476.0	14,393.4	1290.0	2585.1	1200.6
Lbs/gal	....	....	....	....	5.30	5.07	....	5.77	5.62	5.30	5.08	5.07	5.30	4.22	4.83
Mcf/day	30,017	27,134	2,883	26,809	....	....	26,022	....	....	....	....	....	....	....	....

* C_4 and heavier only.

level, 7.6 million BTU per hr. are dissipated, the greater part by the absorber intercoolers. At the 40° F. level 3.6 million BTU per hr. are removed. Approximately 1540 BHP of compressor capacity are required for this load. Wet gas compression accounts for 2200 BHP, so that the total compressor capacity is approximately 3740 BHP, all of it gas engine driven.

A lean oil conditioning still is not required. To prevent a build-up of heavy ends over the butane absorber and still, it is sufficient to circulate a small stream of still bottoms over the debutanizer tower.

Utility requirements have been calculated at 84 million BTU/hr equivalent to 80,000 SCF of dry gas, 155 GPM of makeup water and 350 KW of electric power. The plant is self-contained in regard to steam, so that steam could be included at its equivalent fuel gas value. The cost of utilities is shown in Table 6 based on 10 cents per million BTU's, 6.7 cents per 1000 gallons of makeup water and 1.0 cent per KWH. These figures include the requirements for steam generation and of the cooling water plant.

Cost Comparison

As shown in Table 5 the plant, when recovering 90% of the available propane from 30 million cu. ft. of wet gas, will produce 62,000 gals. of specification LPG-Propane, 29,000 gals. of butanes and 31,000 gals of natural gasoline, a total of 122,000 gals. of liquid products daily. The market value of these products at current prices of 6.0c per gal. for LPG, 6.8c per gal. for butane and 9.4c per gal. for the 16-55 grade of natural gasoline is $8590.

Direct operating expenses consist of labor and supervision (5 men per shift) $228, utilities $319, and "general works expense" of $312, which includes repairs, laboratory, shop and warehouse, and that part of the administrative expense and administrative overhead directly chargeable against production. These costs total $857 per day. The direct cost of production is thus 0.705c per gal. of total liquid products recovered. This is lower than obtained in most conventional plants handling an equal gas volume and recovering gasoline and butanes only. By comparison it is interesting to note that the fuel value of the products recovered at 1c per therm is 0.911c per gal.

TABLE 6—Utility Requirements and Costs

		$ Day
Fuel Gas, million Btu/hr	84.22	200
Makeup Water, GPM	155	15
Electric Power, KWH/Hr	350	84
Desiccant and Miscell.		20
Total		319

There remains the question of initial cost. Contributing to an increase in cost over the conventional absorption plant will be the additional gas compression and the refrigeration plant. Also the drier installation, which, while necessary for the operation of the plant, likewise benefits the dry gas purchaser. On this account the cost of the drier installation may under certain circumstances be recoverable through increased revenue from the sale of the dry gas.

More than balancing these increases, however, is the savings in lean oil circulation, which amounts to only 10.9 gals. per 1000 cu. ft. of wet gas. The completely erected cost has thus been estimated as of the order of $1,900,000. Included in this figure are the estimated cost of the plant proper with three days each of pressure storage for butanes and atmospheric storage for natural gasoline, also steam generation, cooling tower and cooling water pumping plant. Not included are the cost of propane storage, loading facilities, spurs, roads and lines outside the process area or between storage and process area.

Modifications of Existing Plants

If it is conceded that these figures of operating costs and investment are attractive, it may well be asked what modifications to existing plants may be made to increase propane recovery. In the light of what has been said above no all-inclusive answer to this question can be given.

If it were required to expand a plant extracting 95 % of the normal butane from the wet gas of Table 3 such that 90% of the propane would be recovered the most likely solution would be to replace the existing absorber with a fractionating absorber installation operating at a pressure and temperature such that the lean oil circulation would not exceed that of the existing plant. While this lean oil circulation in straight absorption would result in a normal butane factor of approximately 1.1 (12 plates) the same circulation would have to produce a propane factor of 0.97 for a considerably increased volume (due to internal recycle) of vapors.

It is not difficult to find combinations of pressure and temperature which will satisfy this condition; the problem is to determine which of the possible combinations will yield the plant of lowest cost. Increasing the absorber pressure from an initial value of 150 psig, the first additional compression ratio is equivalent to a lowering of the effective absorber temperature by 60° F., the next one to only 37° F. and the third to only 22° F. Refrigerating the lean oil will be found relatively more expensive below pressures of 450 psig than will wet gas compression.

Acknowledgment

The author is indebted to the Lummus Co. for permission to publish this paper and to Dr. E. R. Smoley for assistance in its general aspects. He is grateful to Messrs. M. J. P. Bogart, W. Tucker and J. A. DiPace, all of the Lummus Co., who have perfected the design method and who have performed the necessary calculations in the case of the above absorption plant.

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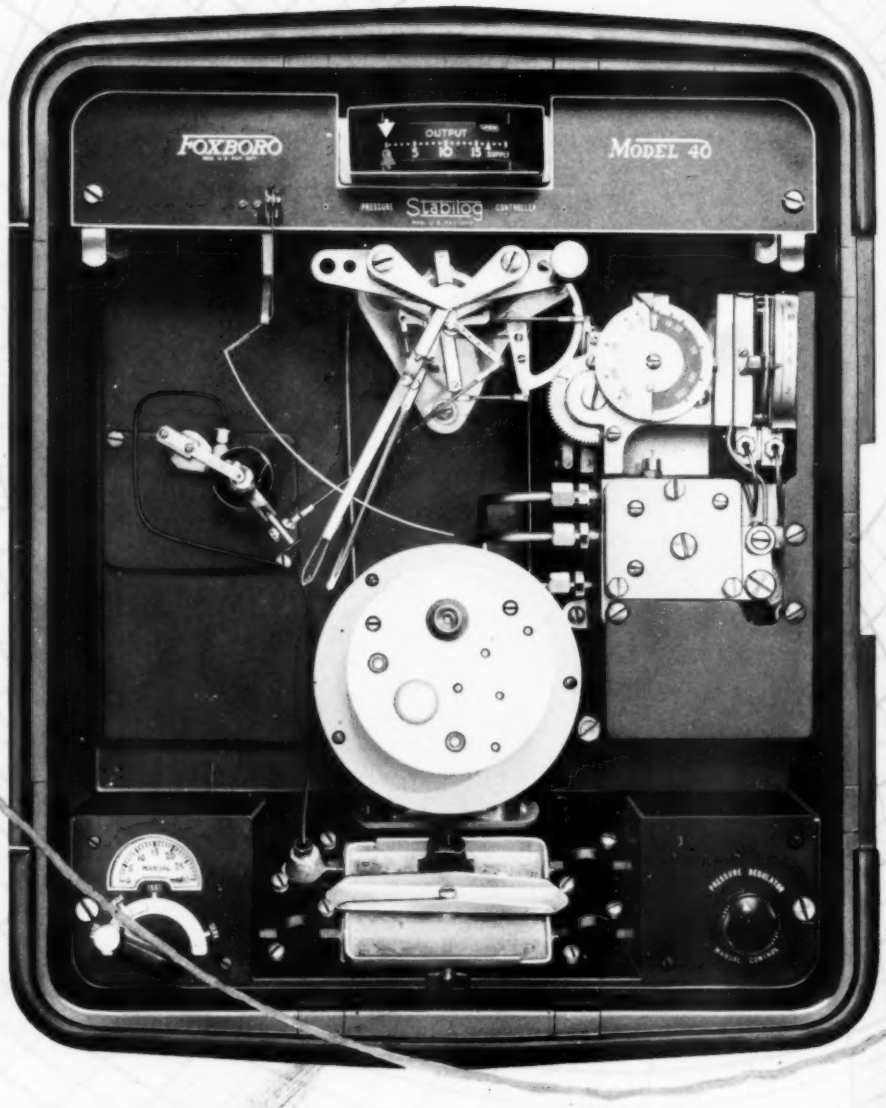

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"THE FINEST MODERN CONTROLLER"

Computer Cuts Time in Direct Determination Of Supercompressibility Factors of Gases

By F. C. WALTERS, Superintendent
Transmission Gas Measurement
Panhandle Eastern Pipe Line Co., Kansas City

IN the handling of gas under high pressure, conventional procedure for obtaining supercompressibility factors is to employ the usual charts and graphs to be found in existing literature. This time-consuming method can be eliminated by the use of a circular computer developed by Panhandle Eastern Pipe Line Co. for the direct reading of supercompressibility factors for natural gas.

It indicates with one setting the value to the fourth place past the decimal point for both displacement and orifice meter measurements. The computer has been found readily adaptable to clerical interpretation and has been in use in Panhandle Eastern's Gas Measurement Dept. since early April of this year.

As illustrated in Fig. 1, it is composed of three polished aluminum plates on which the scales are etched. The outer plate is an annular ring containing the pressure scales and is permanently fixed to a turntable so that the "read" pressure may be brought to proper eye level to facilitate reading. The inner plate, containing the supercompressibility factors, is circular and is also fixed to the turntable except that its position with respect to the pressure scales may be varied in order to calibrate the computer against periodic determinations. After calibrating, it can be fixed in position with the set screws provided on its underside.

Fig. 1—Circular computer for supercompressibility factors is mounted on a tilting wood base to facilitate reading; is easily used by clerical workers in Panhandle Eastern's Gas Measurement office

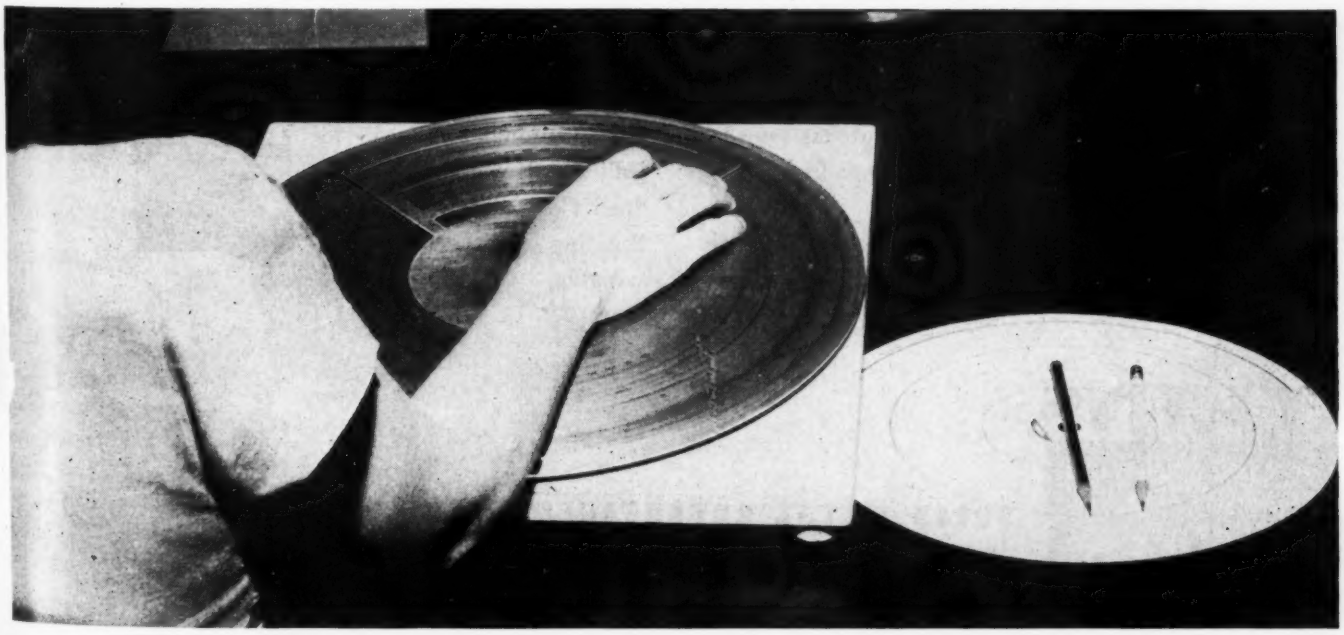
The top plate, containing the index and temperature scales, is a circular segment which rotates on its center. A tilted wooden base, 15 x 15 in. square, supports the turntable on which is mounted the computer. The diameter of the computer is 14 in. The combined weight of the instrument is 6 lbs.

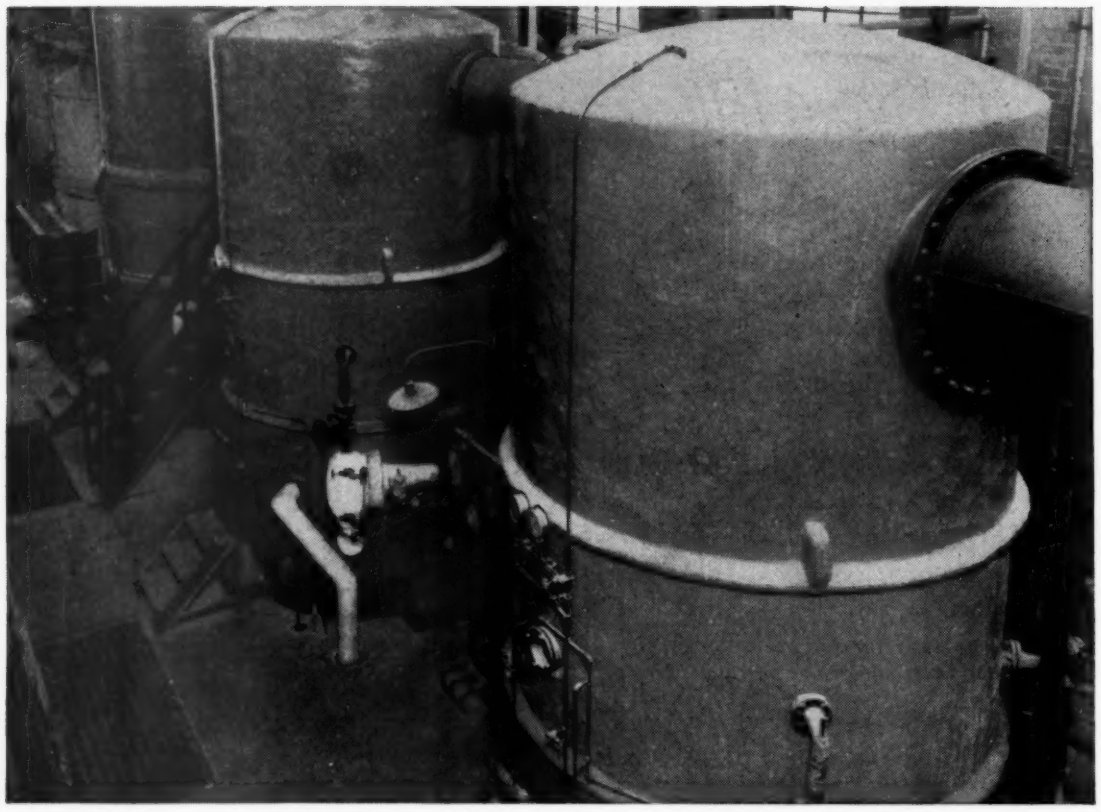
The computer is based on an empirical equation which is generally accepted as standard practice by natural gas companies. Its development and application is set forth in the California Natural Gasoline Assn. Bulletin No. TS-354, dated 1936, and entitled "Tentative Standards for the Determination of Supercompressibility Factors in High Pressure Gas Measurements." The equation may be expressed as follows:

$$N = KP/T^{3.825}$$

where: N = Deviation from Boyle's Law—a decimal
K = A constant
P = Static pressure—psig.
T = Absolute temperature—°/F.

In principle the computer is a circular slide rule from which may be





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read directly the supercompressibility factors to be used in displacement and orifice meter calculations. Since these factors vary with the pressure and temperature of a gas, all three values are incorporated in scales on the computer.

To facilitate accurate reading there are two pressure scales; one low pressure scale ranges from 5 to 100 psig., and the high pressure scale from 50 to 1000 psig. The temperature scales range from 0 to 100 °/F. The supercompressibility factor for displacement meters is denoted as F_d and for orifice meters as F_o. To avoid crowding the notation on the supercompressibility factor scales, the scale notation is limited to the last significant figures of four places past the decimal point, except where the number of significant figures changes from one to two, two to three, etc. At these points, the entire factor is shown in slanted figures.

Since the value of the constant "K" in the above equation varies with the composition of the gas, the computer can be calibrated by setting known temperature and pressure conditions against the value of the supercompressibility factor determined at those conditions, and then locking in place in the proper position the circular section on which is shown the correction factors.

As an example of a calibration, reference is made to Fig. 2. From a test, the deviation from Boyle's Law is found to be 0.0672 at 400 psig. and 60 °/F. Since F_d is equal to $1 + N$, its value is equal to 1.0672 at these temperature and pressure conditions. Therefore, to calibrate the computer, the index is set at 400 psig. on the high pressure scale, and the segment on which is shown the supercompressibility factors scales is rotated so that the value 1.0672 (F_d) on the scale marked "Correction Factors for High Pressure Scale" is in line with 60 on the scale marked "°F. for H. P. Scale." The segment on which is

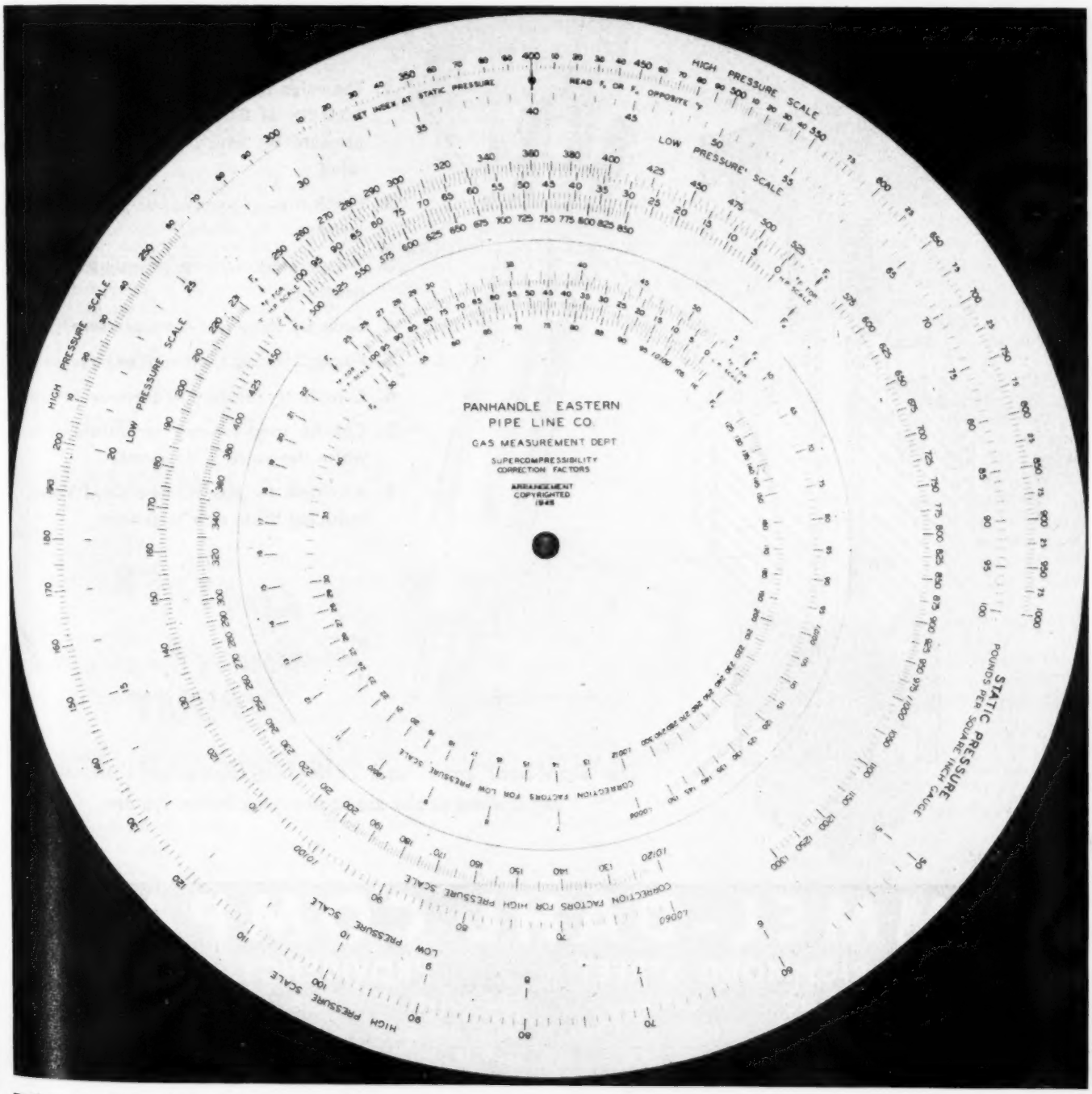

Fig. 2—In operating principle, the computer is a circular slide rule incorporating scales for high and low pressure, temperature, correction factor, and supercompressibility factor

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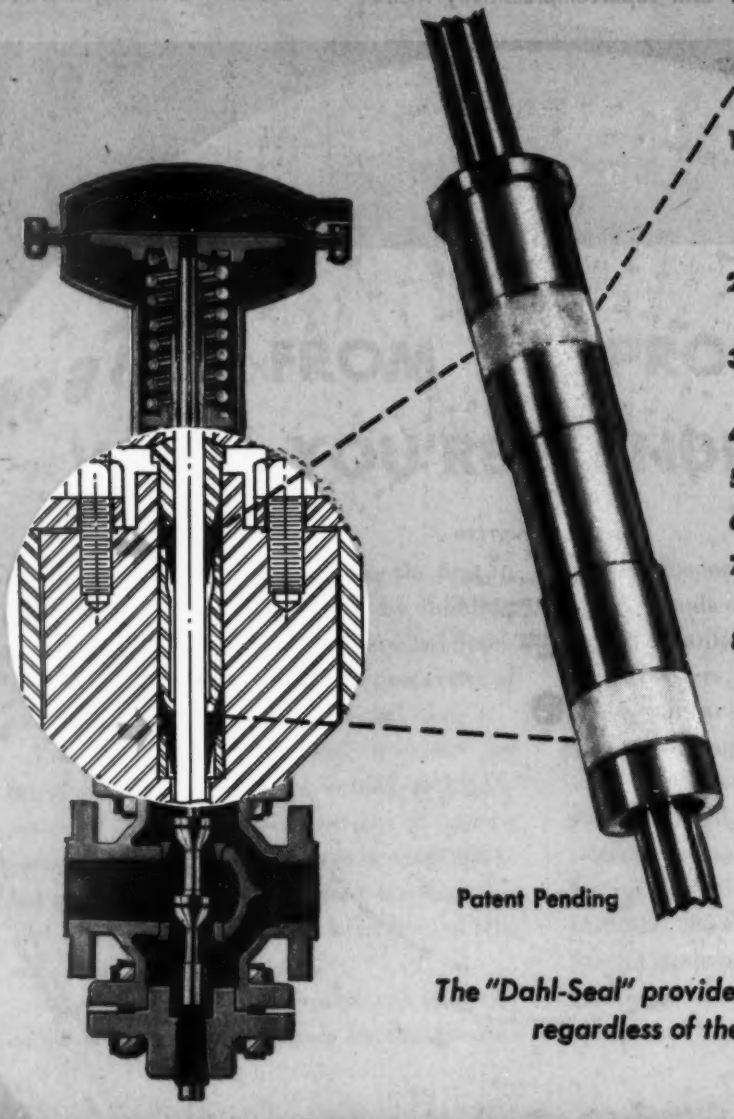

1. The valve stem can be positioned to an accuracy of 0.001" up to the working pressure for which the Valve Body is rated.
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shown the supercompressibility factor scale is then locked in position by means of the set screws. The temperature scale then becomes the only moving part of the computer.

Following the calibration, it is then necessary only to set the index at the required gas pressure and to read the desired factor F_d or F_e opposite the applicable gas temperature on the proper scale.

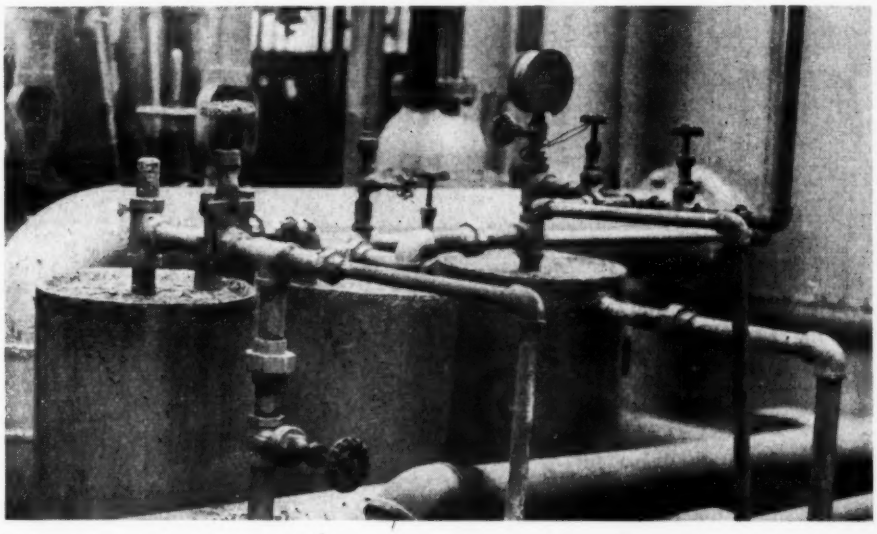
The calibration of a computer will depend upon the frequency of supercompressibility tests or determinations. Some companies use average values as long as such values remain within a set tolerance. Others carry out periodic tests and apply such results during interim periods. It is evident that calibration in most instances will be fairly infrequent, considering general operating practices.

Where factors must be applied in routine operations to gases of different characteristics, the recalibration of one computer for each group of meter charts would be feasible if not required too frequently. The computer has been arranged to that calibration is a simple and fast operation, taking only a few minutes to perform. In some cases, however, it might be desirable to calibrate and assign an individual computer for the handling of each group of charts.

The computer has been copyrighted by Panhandle Eastern Pipe Line Co. and arrangements are being made for its manufacture.

Clean and Moisture-free Gas Is Supplied To Actuate Controllers in Gasoline Plant

By JOHN C. ALBRIGHT



Three small drums connected in series act as scrubbers for instrument actuating gas supplied to recorder-controllers in Wilmington Gasoline Co. plant

AFTER experimenting with many different types of scrubbers and driers to remove all traces of condensate and moisture from actuating gas supplied to recorder controllers in its Terminal Island gasoline plant at Wilmington, Calif., Wilmington Gasoline Co. engineers developed a set of shop-built devices for this purpose.

Gas is obtained on the downstream side of a diethylene glycol, moisture-controlling unit operating on the residue gas delivered to a fuel distributor. The gas is piped to a set of three small scrubbers installed to function in series. Each scrubbing drum is equipped with fittings for inlet and outlet and with blowdown valves to drain the accumulated liquid, if any, from the bottom head. Inlet pipes extend through the top heads toward the base so that any liquid will fall downward and not be carried out with the dried gas.

At the instrument panels, small horizontal drums are also installed with inlet and outlet on the top, and having drain valves on the end opposite the inlet to serve as blowdown. Additional filtering elements, supplied by the instrument manufacturer, are installed between the horizontal receivers and the instruments themselves.

"Smoking Room" Box Car Close to Job, Cuts Time Lost During Smoking Recess

Men like to pause for the "smoke that refreshes" even when they are refinery employes working in hazardous areas. Realizing that too much time can be consumed by a long walk to a safe area during the smoking recess, the management at Sinclair Refining Co.'s East Chicago refinery took steps to provide the desired safe smoking location close to the working area.

Shown in the accompanying photograph, it is an old railroad box car pulled up on the company's in-plant spur. Fitted with benches, it will of course accommodate more than the 40 men or eight horses of World War I's famous French boxcars although it is rarely called upon to do so. The company found the rental fee of 50c per day for the car considerably cheaper than the cost for erecting a permanent shanty. Also, the car can be moved about to various locations on the property as needed.

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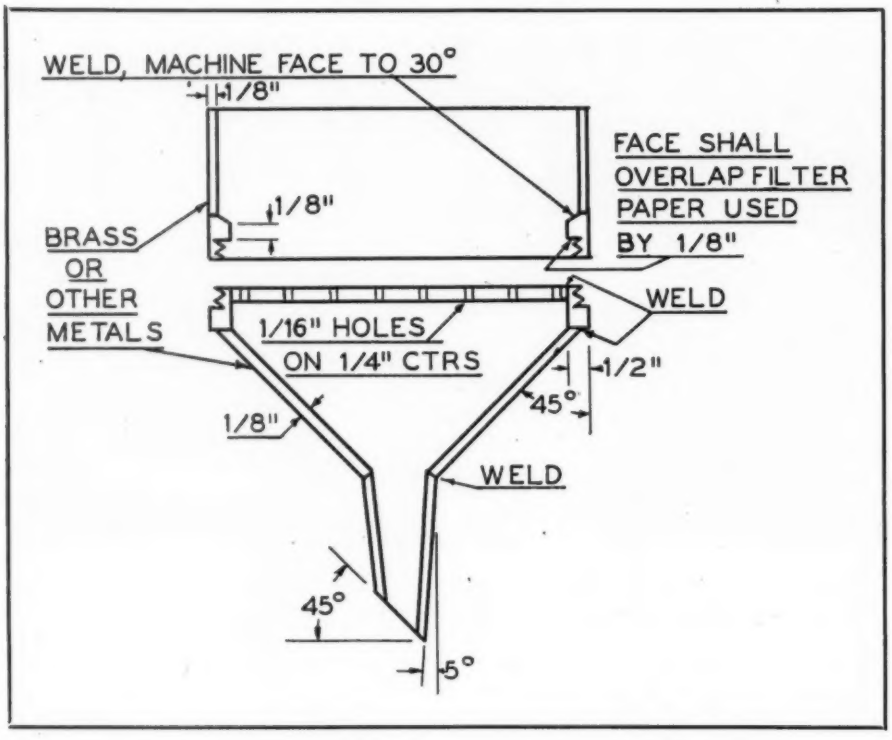

Fig. 1—Metal Buchner-type funnel with screwed connection between plate and rim. Projecting flange clamps paper tightly to plate, avoids leaks

BUCHNER-TYPE funnels made from metal—brass or occasionally alloy steel—are very useful around the refinery laboratory in operations where the funnel must be preheated to temperatures above 250° F or where it may be subjected to thermal shock. The usual porcelain filter has been known to break under these conditions and either ruin a determination or constitute a hazard to the technician. The mechanical fragility of porcelain also is well-known.

Brass Buchner funnels are routine in Humble Oil & Refining Co. laboratories for control test and even research where lubricating oil must be handled at high temperatures (such as in clay contacting) or very low temperatures (dewaxing). They have been further modified to permit clamping filter paper in place to avoid leaks.

A common design in shown in Fig. 1. The upper rim is connected to the funnel proper by a thread connection, and further carries a narrow flange which extends slightly over the perforated plate. If filter paper is placed on the plate before the rim is screwed on, it will hold the paper firmly and prevent leaks. It is not necessary to wet the filter paper with the material prior to filtering. Likewise, there is no danger of the paper "floating" should the filterable material be poured in too rapidly.

In laboratory dewaxing operations at temperatures of around 0° F and below the screwed-type Buchner is particularly valuable since it is usually difficult to obtain a good seal between filter paper and plate unless the former is clamped in some manner.

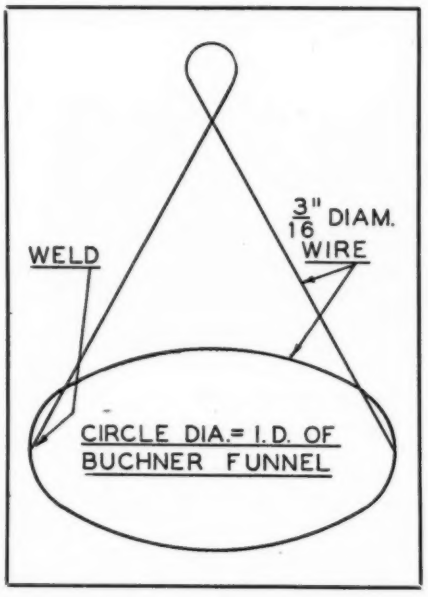

Fig. 2—Metal bail for use with metal or porcelain Buchner funnels to hold filter paper tightly to perforated plate prevents leaks

In this connection, where the time required to assemble the screwed-type metal Buchner is undesirable, a one-piece Buchner may be used with a brass ring and bail (as shown in Fig. 2) placed on the paper before filtering commences. The weight of the ring, assuming the perforated plate is flat, will prevent the paper from floating when the liquid to be filtered is poured in and eliminate necessity of prewetting the paper. The metal ring may be made of brass or any other desirable metal, and the loop in the bail is convenient for hanging the ring when not in use.

Funnels and bails are inexpensively fabricated from odds and ends and are virtually indestructible where properly used.

Drinking Fountain Water Speeds Cooling of Flash Tester Jacket

AN EASY way to speed up flash tests on low-flash materials — kerosine and naphthas — using the Tagliabue Closed Tester, is by charging the water jacket with cool water, either from laboratory lines or from a drinking fountain stream. The latter is preferred if it is of the refrigerated type and conveniently located.

The major amount of lost time between successive flash determinations is that required to cool the jacket water, sample container, and sample to the desired starting temperature; at least 20° F. below the probable flash point.

The usual procedure is to drain the water jacket and refill with cool water, or wait for the water to cool normally. If the jacket is filled too full, subsequent heating will cause some water to overflow.

By connecting the jacket to the water supply, plugging the normal water outlet, and providing a drain connected to the sewer and located to maintain the desired water level in the jacket; the tester can be modified inexpensively without involving any departure from the required standard procedure for the test itself.

Immediately upon completion of a test the sample is dumped and the container replaced. Cool water then is allowed to flow until the desired jacket temperature is reached. Water is then cut off, a new sample poured into the now cool container, and the test is conducted in the usual manner. This method is in successful use in the control laboratories of the Baytown refinery of Humble Oil & Refining Co.

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Equal volumes of the sample and aniline are mixed, heated at a controlled rate, stirred until homogeneous, then cooled at a controlled rate until the cloud point is noted. The temperature at which the mixture becomes clear thru-out is the "aniline point". Procedure is covered by A.S.T.M. D-611-47T.

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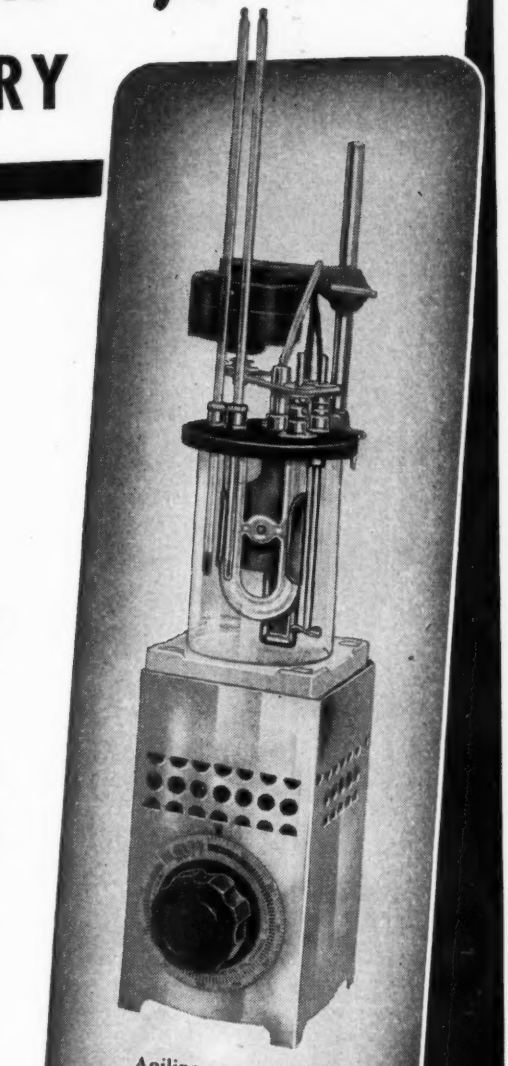
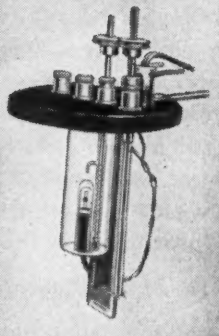


Aniline apparatus with "U-Tube" unit.



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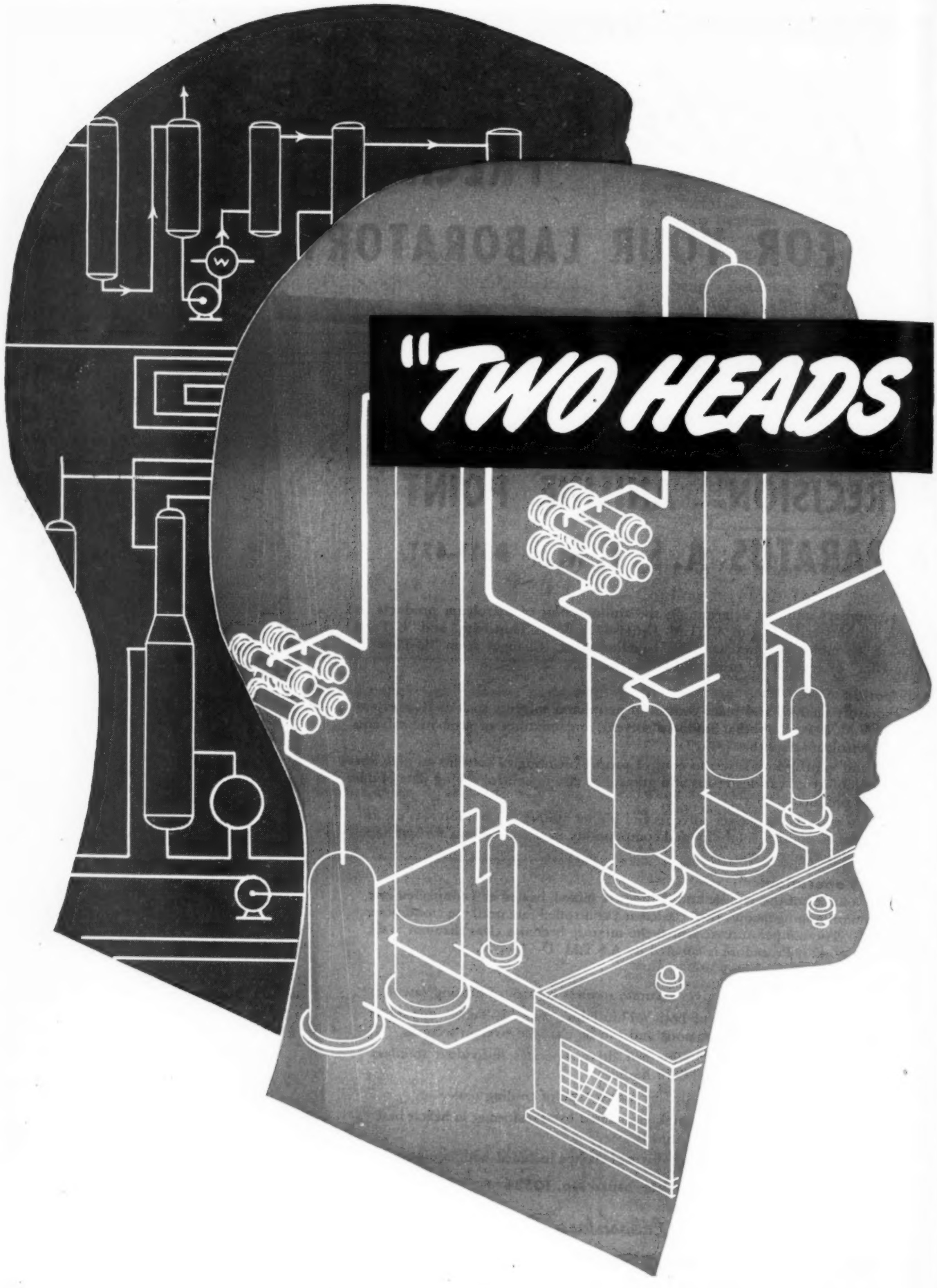
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UTILIZATION of REFINERY GASES By the POLYFORM PROCESS*

By W. C. OFFUTT, M. C. FOGLE, and H. BEUTHER
Gulf Research & Development Co., Pittsburgh

Flexibility inherent in the Polyform process provides for adapting it to various plant operations to achieve maximum gasoline production. Highest output of gasoline from a Polyform unit can be assured by charging a maximum of naphtha and by maintaining the olefin content of the circulating gas at a high level. The circulating gas can be enriched with C_3 and C_4 fractions produced as a by-product of catalytic cracking. The naphtha charge can also be supplemented with catalytic furnace oil when available.

Data is presented on operations charging outside gas on a once-through or partial recycle basis, where part of the gas, largely paraffinic, remains unconverted and is rejected from the system, and a major portion of the Polyform furnace capacity is available for naphtha charge. A correlation chart is presented for estimating gasoline yields and octane numbers charging virgin naphthas and outside propane-propylene on a once-through or partial recycle basis.

FOR MANY YEARS the Polyform process has been an efficient method for the conversion of low-octane naphthas and excess refinery gases to attractive yields of motor fuels having high motor and research octane quality. The inherent flexibility of the process has made it possible to adapt both existing and new Polyform installations to the constantly changing demands imposed by seasonal variations in refinery operations and by modernization of facilities for processing other crude fractions.

Continued development work has been directed toward keeping abreast with the current refining trends of increased crude runs and maximum production of gasoline, by combining the features of maximum naphtha charge and conversion of outside refinery gases for economical utilization of Polyform capacity.

In naphtha polyforming a relatively low-octane petroleum fraction is reformed thermally at high temperatures and high pressures in the presence of a circulating stream of liquefiable gases which may be derived from cracking of the naphtha (self-contained operation) or from outside sources. Experimental work(1) has demonstrated that alkylation, polymerization, and other reactions of the addition type take place in the Polyform furnace between the hydrocarbons in the circulating gas and the products from cracking of the naphtha, and result in an increase in the yield of gasoline compared to conventional reforming.

The catalytic cracking processes produce large quantities of C_3 and C_4 fractions which contain olefin concentrations of 50 to 70%. As the normal circulating gas in self-contained polyforming operations contains only 12 to 15% unsaturates, olefinic refinery gases may be used to enrich the circulating gas stream. In this manner the gasoline production of a unit designed for self-contained polyforming may be increased con-

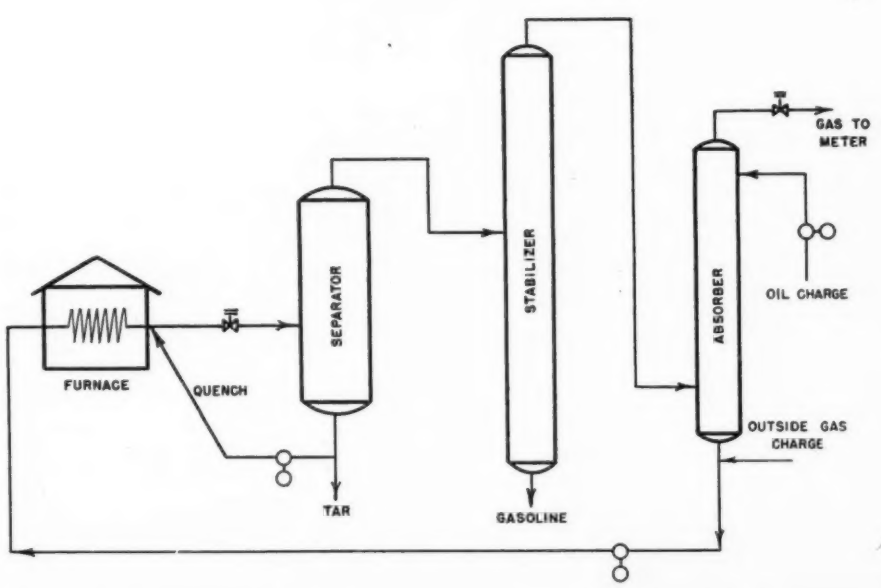


Fig. 1—Schematic flow sheet for the Polyform process

* Presented before the National Petroleum Assn., Atlantic City, Sept. 15-17, 1948.

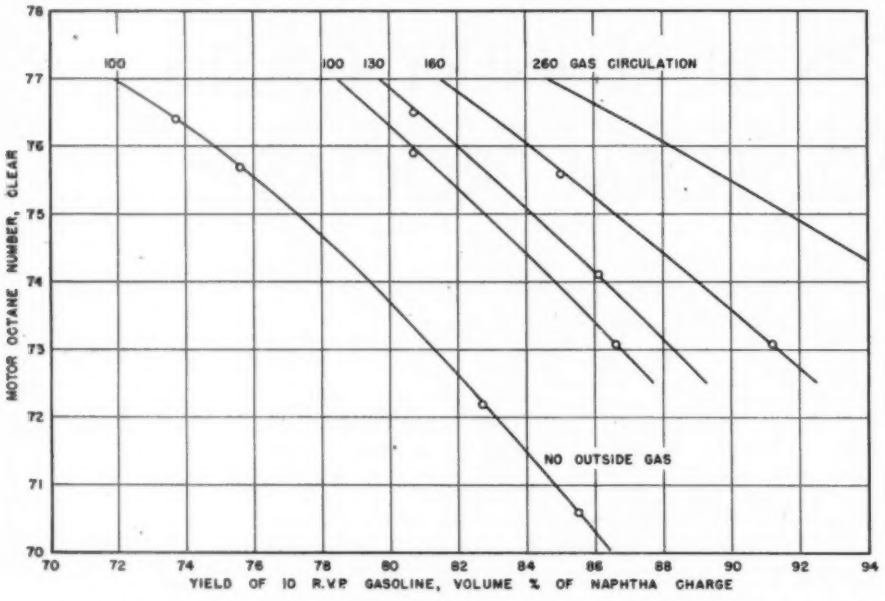


Fig. 2—Yield of gasoline plotted against motor octane number, for polyforming Mid-Continent naphtha with 30% of outside propane-propylene (60% olefin); effect of total gas circulation

siderably due to the more rapid rate of conversion of olefins compared to paraffins. Units designed for operation with outside gas may be more heavily loaded with naphtha charge to increase the production of high-octane fuel, without sacrificing the yield of gasoline from the olefinic components of the outside gas.

Previously published information,[1],[2] on the Polyform process has included data from self-contained operations on a variety of naphthas and from operations in which outside refinery gases were recycled for maximum gasoline yield. In most of the work discussed in the earlier literature, both the paraffinic and olefinic components of the outside gas were converted almost completely by providing sufficient capacity for the required volume of gas recycle. More extensive data are now available on operations charging outside gas on a once-through or partial recycle basis, where part of the outside gas, largely paraffins, remains unconverted and is rejected from the system, and a major portion of the capacity of the Polyform furnace is available for naphtha charge.

The flow for naphtha polyforming with outside gas is essentially the same as that used for self-contained polyforming in which the recycle gases are derived entirely from cracking of the naphtha. The liquefied C_3 or C_4 fraction is pumped directly into the rich naphtha stream, leaving the base of the absorber as shown in Fig. 1. The mixture is pumped to the cracking furnace, which is operated at outlet temperatures in the range of 1025 to 1100° F. and pressures of 1000 to 1500 psi.

The effluent from the furnace is quenched and then flashed to separate tar and gasoline. The gasoline is stabilized to the desired vapor pressure, and the overhead gases from the stabilizer are passed into the bottom of the absorber. Fresh naphtha charge is pumped to the top of the absorber, where it selectively absorbs the quantity of C_3 and C_4 hydrocarbons which is desired as recycle. Unconverted propane and propylene are rejected from the top of the absorber with the lighter gases and may be recovered for sale as liquefied petroleum gas or for other purposes.

Self-contained polyforming operations maintain a sufficient gas dilution in the cracking furnace to permit long, coke-free runs in the plant. Naphthas of 20 to 45 octane number usually require a gas circulation of about 100 vol. % based on naphtha charge when a distillate having a motor octane number in the range of 76 is produced. Although the C_3 and C_4 fractions produced by cracking of the naphtha contain 40 to 60% of unsaturates, the olefins are converted rapidly by recycling and the equilibrium olefin concentration in the circulating gas stream is only 12 to 15%.

Since the amount of gasoline produced from the circulating gas is largely a function of its olefin content, any outside refinery gas stream which is capable of increasing the olefin content of the circulating gas stream can be utilized to advantage without increasing the total amount of gas recycle. The increase in gasoline yield realized from the outside gas is dependent upon its volume and olefin content. When propane-propylene from catalytic cracking is charged to a Polyform operation, a major portion of the olefins are con-

TABLE 1—Polyforming of Mid-Continent Naphtha with Outside Propane-Propylene

Effect of Total Gas Circulation

Outside Gas	None	30% Propane-Propylene (60% Olefin)			
Total Gas Circulation, vol. % of naphtha charge	100	100	130	160	260
Yields, vol. % of naphtha charge					
Gasoline (10 R.V.P., 400° F. E.P.)	74.7	80.7	82.0	84.1	88.2
Gas (C_2 and Lighter), F.O.E.	13.0	13.0	13.0	13.0	18.1
Propane-Propylene	2.2	21.6	19.7	15.7	2.2
Tar	8.4	10.4	10.4	10.4	8.4
Octane Numbers of Gasoline					
Motor, clear	76.0	76.0	76.0	76.0	76.0
Research, clear	87.2	86.7	87.3	87.6	85.4
Research, +3 cc. T.E.L.	94.4	94.6	95.2	95.7	94.6
Gasoline Yield from Outside Gas, vol. % of gas charge.		20	24	31	45
Outside Gas Converted, vol. % of gas charge		35	42	55	100
Gasoline Yield from Converted Gas, vol. % of gas converted		57	58	57	45

TABLE 2—Polyforming of Mid-Continent Naphtha with Outside Butane-Butene

Effect of Total Gas Circulation

Outside Gas	None	30% Butane-Butene (50% Olefin)			
Total Gas Circulation, vol. % of naphtha charge	100	100	130	160	230
Yields, vol. % of naphtha charge					
Gasoline (10 R.V.P., 400° F. E.P.)	74.7	79.8	82.5	85.1	91.5
Gas (C_2 and Lighter), F.O.E.	13.0	13.7	14.1	15.1	18.4
Propane-Propylene	2.2	19.9	16.6	14.0	2.2
Tar	8.4	10.3	10.3	10.3	9.0
Octane Numbers of Gasoline					
Motor, clear	76.0	76.0	76.0	76.0	76.0
Research, clear	87.2	88.5	88.5	88.3	86.3
Research, +3 cc. T.E.L.	94.4	96.3	96.2	95.9	95.1
Gasoline Yield from Outside Gas, vol. % of gas charge		17	26	35	56

verted to gasoline with no increase in gas circulation. The unconverted propane-propylene which is lean in olefins is rejected from the unit.

Effect of Gas Circulation on Conversion of Propane-Propylene

Polyform operations charging a Mid-Continent naphtha of 34 octane number indicate that a substantial quantity of olefinic propane-propylene can be converted to gasoline without altering the naphtha charge rate and without increasing the total gas circulation of a self-contained unit. The conversion of outside gas and production of gasoline may be increased further, however, by providing additional capacity for recycling of gas.

Figs. 2 and 3 show yields of gasoline plotted against Motor and Research octane numbers, respectively, for self-contained polyforming operations charging Mid-Continent naphtha and operations with 30 vol. % (based on naphtha charge) of propane-propylene produced by catalytic cracking and containing 60 mol. % of propylene. The runs charging the outside gas were made with 100, 130, and 160 vol. % of total gas circulation, compared to 100 vol. % for the self-contained operations. Fig. 2 includes a curve for operations in which the outside propane-propylene was recycled until completely converted.

The effect of total gas circulation is shown quantitatively in Table 1 for comparable operations producing distillates of 76 Motor octane number. The increase in gasoline yield, with no increase in gas circulation, was 6% based on naphtha charge, or 20 vol. % of the outside propane-propylene charge. As 35% of the outside gas was converted under these conditions, the gasoline yield based on propane-propylene converted was 57 vol. %. This percentage of gasoline from the gas converted was maintained with moderate recycling, and the conversion of the outside gas was increased to 55% with a total gas circulation of 160% based on naphtha charge. Although the conversion of outside gas and gain in gasoline yield are a function of the extent to which gas is recycled, there appears to be little advantage in operating with total gas circulations above 160% in this type of operation due to the excessive polyforming capacity required.

Effect of Gas Circulation on Conversion of Butane-Butene

Similar results are obtained by charging excess butane-butene from catalytic cracking to a polyforming operation on Mid-Continent naphtha. Figs. 4 and 5 show the yield versus octane number relationships for operations charging 30 vol. % (based

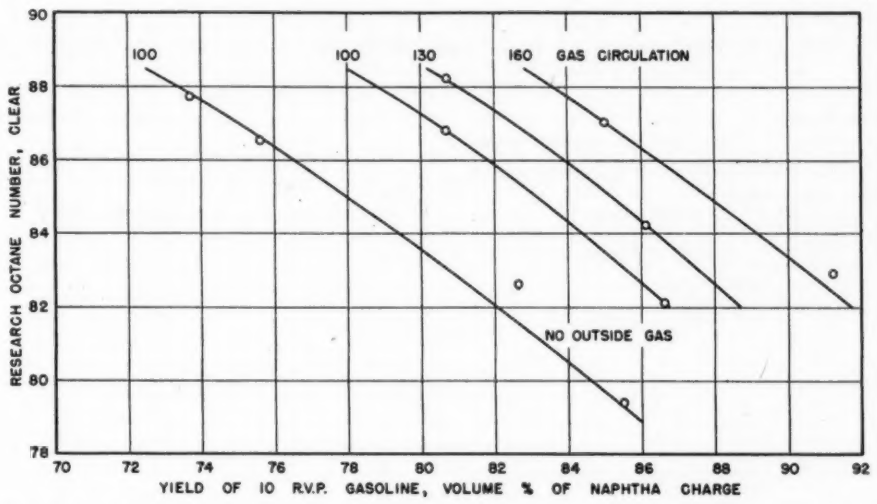


Fig. 3—Yield of gasoline plotted against Research octane number, for polyforming Mid-Continent naphtha with 30% outside propane-propylene (60% olefin); effect of total gas circulation

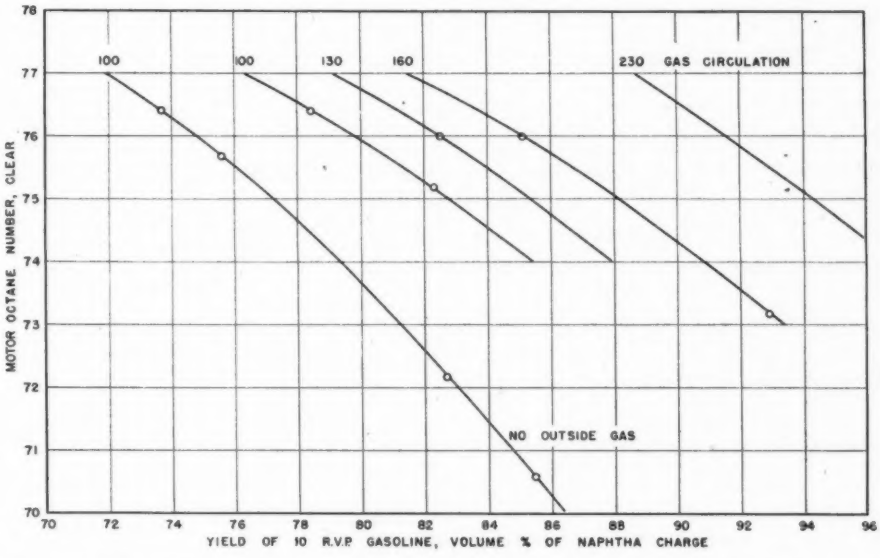


Fig. 4—Yield of gasoline plotted against Motor octane number, for polyforming Mid-Continent naphtha with 30% outside butane-butene (50% olefin); effect of total gas circulation

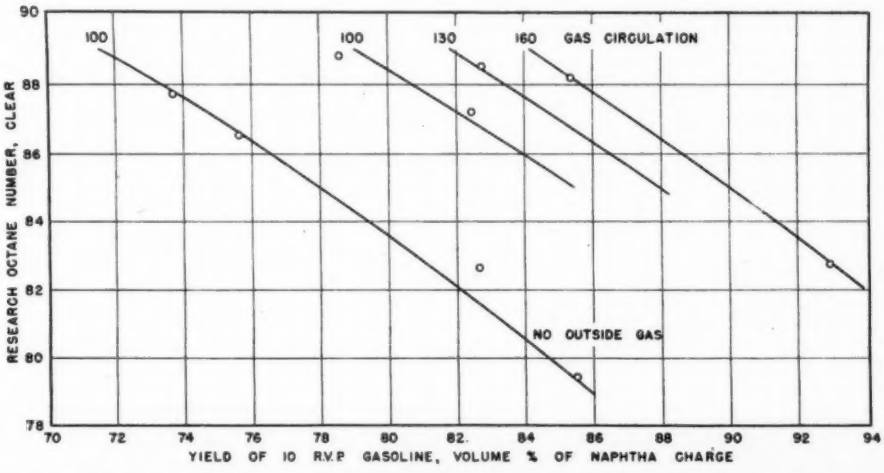


Fig. 5—Yield of gasoline plotted against Research octane number, for polyforming Mid-Continent naphtha with 30% outside butane-butene (50% olefin); effect of total gas circulation

TABLE 3—Polyforming of Mid-Continent Naphtha with Outside Propane-Propylene and Outside Butane-Butene

Effect of Total Gas Circulation

Outside Gas	None	Propane-Propylene			Butane-Butene		
Amount of Gas, vol. % of naphtha charge		30	30	30	30	30	30
Olefin Content of Gas, vol. %		60	60	60	50	50	50
Gas Circulation, vol. % of naphtha charge	100	100	130	160	100	130	160
Operating Conditions							
Furnace Outlet Temperature, ° F.	1095	1085	1085	1085	1085	1085	1085
Furnace Pressure, lbs./sq. in.	1500	1500	1500	1500	1500	1500	1500
Yields, vol. % of naphtha charge							
Gasoline (10 R.V.P., 400° F. E.P.)	73.7	80.7	80.7	85.0	78.4	82.5	85.1
Excess Butane-Butene	0.6	0.6	0.8	0.3	3.5	1.5	1.5
Propane-Propylene	2.6	21.6	20.0	11.1	19.9	19.9	13.8
Gas (C_2 and Lighter), F.O.E.	13.3	13.6	13.7	15.8	15.0	14.2	15.8
Tar	8.9	9.8	10.6	10.2	10.6	9.6	9.9
Inspections	**Charge Stock**	**10 R.V.P. Gasoline**					
Gravity, °A.P.I.	50.0	54.8	54.8	54.9	55.8	54.9	55.1	54.9
Bromine Number		63	59	62	62	62	62	61
Aniline Point, ° F.		69	72	71	75	68	72	71
Characterization Factor	11.88							
A.S.T.M. Distillation, ° F. (D86-46)								
I.B.P.	198	94	99	104	95	88	91	106
10%	284	121	130	132	127	122	129	135
50%	338	245	246	248	239	240	249	251
90%	385	364	364	362	357	360	362	366
E.P.	418	394	404	402	391	396	400	400
Octane Numbers								
Motor, clear	33.8	76.4	75.9	76.5	75.6	76.4	76.0	76.0
Motor, +1 cc. T.E.L.		80.4	79.5	81.1	80.7	81.4	80.9	81.0
Motor, +3 cc. T.E.L.		83.3	84.0	83.5	84.0	84.3	84.5	84.4
Research, clear		87.7	86.8	88.2	87.0	88.8	88.5	88.2
Research, +1 cc. T.E.L.		92.4	92.5	93.2	92.4	93.9	92.9	93.4
Research, +3 cc. T.E.L.		94.8	95.4	95.7	95.4	96.6	95.2	95.9

TABLE 4—Polyforming of Mid-Continent Naphtha with Outside Propane-Propylene (60% Olefin)

Effect of Amount of Outside Gas at 100% Total Gas Circulation

Amount of Outside Gas, vol. % of naphtha charge	0	15	30	50
Yields, vol. % of naphtha charge				
Gasoline (10 R.V.P., 400° F. E.P.)	74.7	78.0	80.7	85.2
Gas (C_2 and Lighter), F.O.E.	13.0	13.0	13.0	13.0
Propane-Propylene	2.2		21.6	34.2
Tar	8.4	9.0	10.4	11.2
Octane Numbers of Gasoline				
Motor, clear	76.0	76.0	76.0	76.0
Research, clear	87.2	86.4	86.7	86.8
Research, +3 cc. T.E.L.	94.4	94.4	94.6	94.7
Gasoline Yield from Outside Gas, vol. % of gas charge		22	20	21
Outside Gas Converted, vol. % of gas charge			35	36
Gasoline Yield from Converted Gas, vol. % of gas converted			57	58

TABLE 5—Polyforming of Mid-Continent Naphtha with Outside Propane-Propylene

Effect of Amount of Outside Gas

Outside Gas	None	Propane-Propylene		
Amount of Gas, vol. % of naphtha charge		15	30	50
Olefin Content of Gas, vol. %		60	60	60
Gas Circulation, vol. % of naphtha charge	100	100	100	100
Operating Conditions				
Furnace Outlet Temperature, °F.	1095	1085	1085	1070
Furnace Pressure, lbs./sq. in.	1500	1500	1500	1500
Yields, vol. % of naphtha charge				
Gasoline (10 R.V.P., 400° F. E.P.)	73.7	78.8	80.7	89.7
Excess Butane-Butene	0.6	2.6	0.6	1.2
Propane-Propylene	2.6	12.5	21.6	33.4
Gas (C_2 and Lighter), F.O.E.	13.3	11.4	13.6	10.9
Tar	8.9	8.1	9.8	9.3
Inspections	**Charge Stock**	**10 R.V.P. Gasoline**		
Gravity, ° A.P.I.	50.0	54.8	54.7	54.8	56.3
Bromine Number		63	59	59	57
Aniline Point, ° F.		69	76	72	85
Characterization Factor	11.88				
A.S.T.M. Distillation, ° F. (D86-46)					
I.B.P.	198	94	92	99	94
10%	284	121	129	130	130
50%	338	245	255	246	264
90%	385	364	365	364	372
E.P.	418	394	402	404	400
Octane Numbers					
Motor, clear	33.8	76.4	75.0	75.9	74.0
Motor, +1 cc. T.E.L.		80.4	79.8	79.5	79.3
Motor, +3 cc. T.E.L.		83.3	82.9	84.0	82.4
Research, clear		87.7	85.3	86.8	84.0
Research, +1 cc. T.E.L.		92.4	91.6	92.5	90.0
Research, +3 cc. T.E.L.		94.8	93.9	95.4	92.9

on naphtha charge) of butane-butene at various percentages of total gas circulation. The same relations to the base curve for self-contained polyforming as those obtained with outside propane-propylene are found to exist.

Table 2 shows a comparison of yields at a constant level of 76 Motor octane number. When no increase was made in the total gas circulation, the gain in yield of gasoline was 5.1 vol. % based on naphtha, or 17% of the butane-butene charged. Nearly all of the unconverted butane-butene was retained in the circulating gas in these operations due to the preferential absorption of the heavier components of the stabilizer gas, and a large amount of propane-propylene was rejected from the unit. Increasing the total gas circulation resulted in additional gains in yield of gasoline and less rejection of propane-propylene.

Table 3 presents more complete data on yields and quality of products from representative polyforming operations on Mid-Continent naphtha with outside propane-propylene and outside butane-butene at various gas circulation rates.

Effect of the Amount of Propane-Propylene Charge

Polyforming operations on Mid-Continent naphtha at 100 % total gas circulation indicate that the conversion of highly unsaturated outside propane-propylene and the yield of gasoline obtained from the outside gas are relatively independent of the amount of gas charged. Figs. 6 and 7 show yields plotted against Motor and Research octane numbers

for operations charging 15, 30, and 50 vol. % of propane-propylene from catalytic cracking, as compared to operations with no outside gas. The production of gasoline from the Polyform unit increased steadily with the amount of outside gas pumped into the cracking furnace.

Table 4 shows data selected from the curves in Figs. 6 and 7 for the production of gasolines of 76 Motor octane number. The gain in gasoline yield was 20 to 22% of the propane-propylene charge for each of the various amounts of outside gas from 15 to 50% based naphtha charge. However, there is a limit to the amount of outside gas that a unit can charge and yet maintain this rate of gasoline production from the outside gas. A summary of yields, charge and gasoline inspections, and operating conditions for representative polyforming operations charging various amounts of outside gas is presented in Table 5.

Effect of Olefin Content of Propane-Propylene Charge

The olefinic gas content of the furnace charge in naphtha polyforming is the principal factor in determining the gasoline production from the circulating gas stream. For this reason it is beneficial to charge outside gases which are considerably richer in olefins than the circulating gas stream of the self-contained polyforming operation. This circulating gas usually contains between 5 and 20% of olefins, depending upon the type of naphtha, cracking severity, and other operating variables. Both the volume and unsaturation of the outside gas charged to the unit are factors which determine the increase in olefinic gas content of the furnace charge and, as a result, the gain in gasoline production.

Figs. 8 and 9 show curves of yields versus octane numbers for polyforming operations charging Mid-Continent naphtha with no outside gas and with 30 vol. % of propane-propylene containing 40, 60, and 75% of olefins. The gas circulation was 100% for all operations in order to maintain full naphtha charge capacity. It is evident that the olefin content of the outside gas is reflected by increased yields of gasoline.

Table 6 shows yields obtained from the curves in Figs. 8 and 9 at a constant Motor octane number of 76. As the conversion of the propane-propylene containing 40% of olefin was low, a relatively small increase in gasoline yield was realized from this gas. Additional capacity for gas circulation must be provided to derive an appreciable gain from gas of low olefin content. Since extensive conversion of the outside gases containing 60 and 75% of olefin occurred, sizeable increases in gasoline production were obtained. Table 7 contains operating conditions, yields, and product inspection data for typical operations on Mid-Continent naphtha with outside propane-propylene of varying olefin content.

Yields from Outside Propane-Propylene

A simple correlation chart has been developed from all of the experimental data on polyforming of Mid-Continent naphtha with outside propane-propylene. Fig. 10 relates the yield of gasoline produced from the outside gas charged, and the yield of unconverted propane-propylene to the amount of gas charged, the olefin content of the outside gas, and the total gas circulations at which the operation is performed. The estimated yields from this chart are considered to be valid for a wide range of operating conditions: distillate octane numbers of 74 to 77, olefin con-

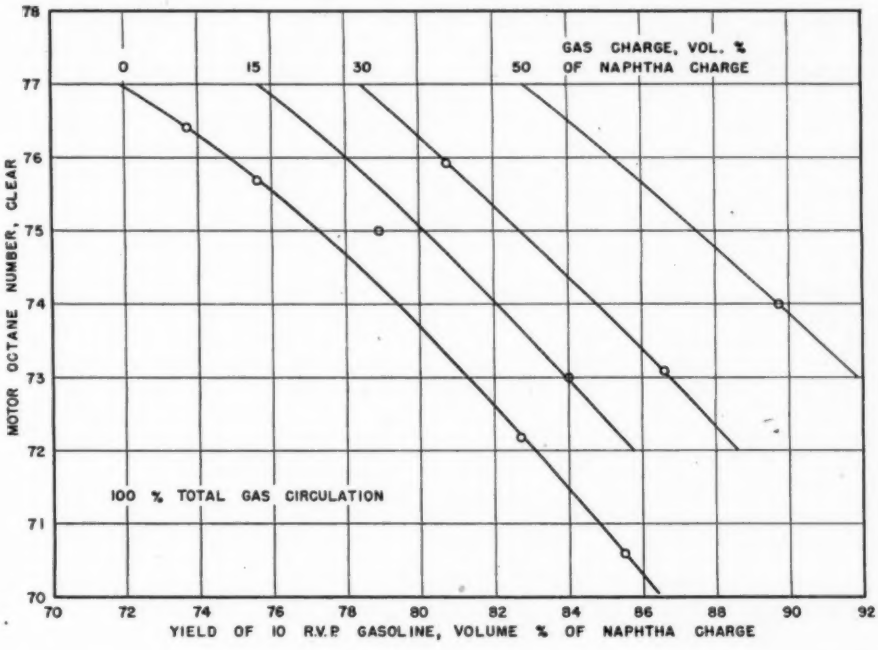


Fig. 6—Yield of gasoline plotted against Motor octane number for polyforming Mid-Continent naphtha with outside propane-propylene (60% olefin); effect of amount of gas

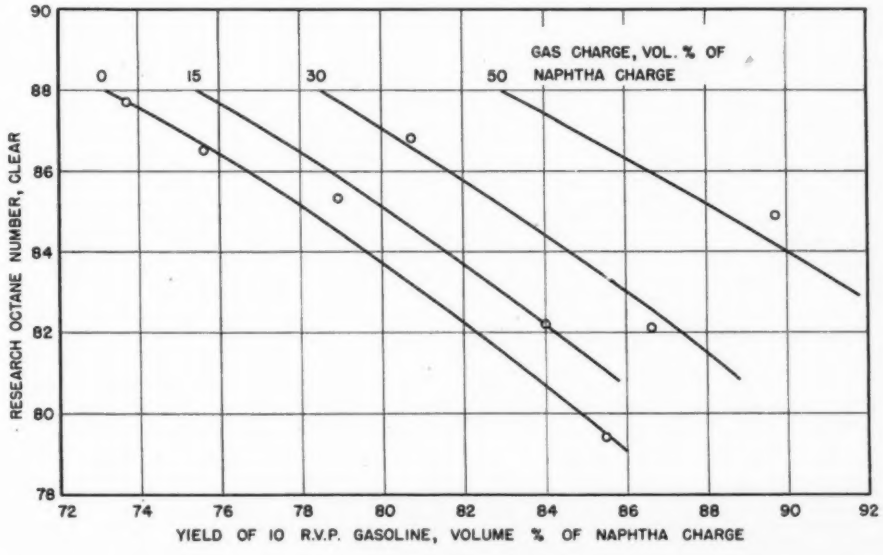


Fig. 7—Yield of gasoline plotted against Research octane number for polyforming Mid-Continent naphtha with outside propane-propylene (60% olefin); effect of amount of outside gas at 100% of total gas circulation

tent of the outside gas of 25 to 80 mol. %, amount of outside gas of 0 to 60 vol. % based on naphtha charge, and total gas circulation of 100 vol. % up to the requirement for essentially complete conversion of the propane-propylene.

Although Fig. 10 was prepared from data on Mid-Continent naphtha exclusively, it appears that estimates of conversions and gasoline yields from outside gas can be made with relative safety for polyforming operations charging other virgin naphthas at a comparable cracking severity. The type of naphtha charge does not appear to be an important variable in the conversion of outside gas where low gas circulations are employed. Operations in which outside gas is recycled until completely converted show that the naphtha charge has a significant effect upon the ultimate yield of gasoline from the gas and the gas circulation required.

Table 8 presents data on yields, product quality, and operating conditions for representative polyforming operations charging outside propane-propylene with Eastern Venezuela, Ordovician, and desulfurized West Texas naphthas, in addition to Mid-Continent naphtha. The table includes one operation on each stock with no outside gas at a gas circulation of 100 vol. % per cent, and operations charging 30% of outside gas with no increase in gas circulation. If variations in octane numbers of the Polyform distillates are considered in comparing yields with and without outside gas, this work indicates that the additional yields of gasoline obtainable from the outside gas are approximately the same for each naphtha. These naphthas represent a fairly wide range of charge stock properties, such as gravity, boiling range, octane number, and characterization factor.

On the basis of these reults from miscellaneous naphthas, it is believed that reasonable estimates of gasoline yields and octane numbers can be made quickly for other operations charging virgin naphthas and outside propane-propylene on a once-through or partial recycle basis. This type of

Polyform Units— Installed Capacity

Company and Location	Polyforming Circulation b/d
Gulf Oil Corp.	
Pittsburgh	5,500
Toledo	5,500
Philadelphia*	6,000
Philadelphia	9,000
Cincinnati	13,000
Philadelphia	16,000
Port Arthur*	57,000
Port Arthur	32,000
Socony Vacuum Oil Co.	
E. Chicago	12,500
Trenton, Michigan	17,500
Magnolia Petroleum Co.	
Beaumont	40,000
Union Oil Co. of California	
Wilmington*	37,500
British American Oil Co.	
Clarkson, Ontario	14,500

* Combination Crude Unit & Polyforming

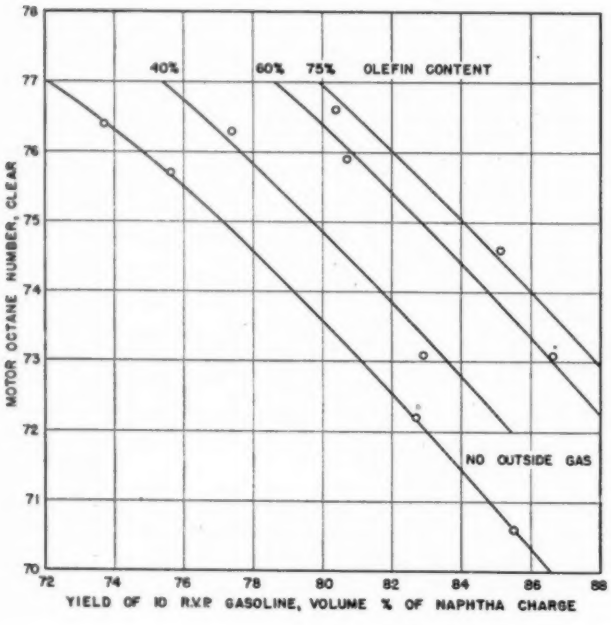


Fig. 8 — Yield of gasoline plotted against Motor octane number for polyforming Mid-Continent naphtha with 30% outside propane-propylene; effect of olefin content of outside gas at 100% total gas circulation

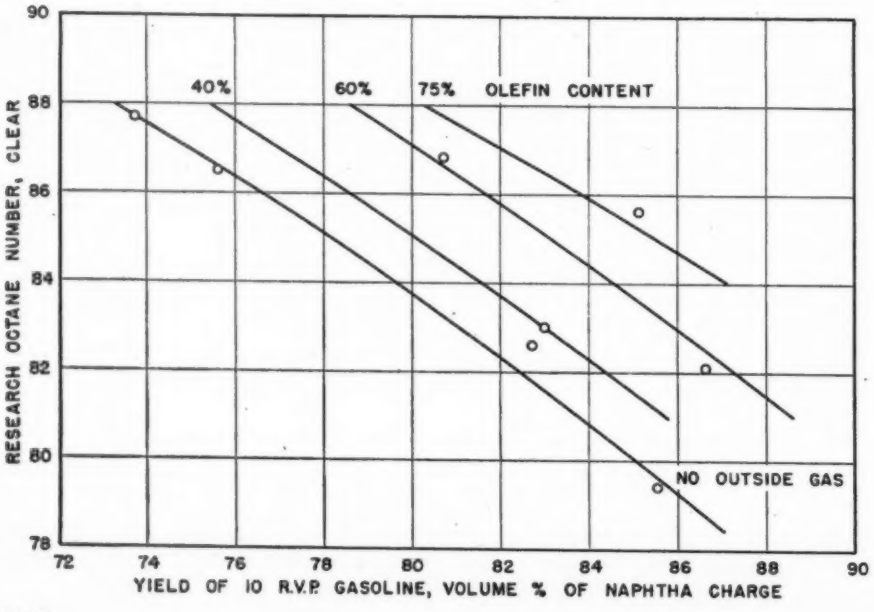
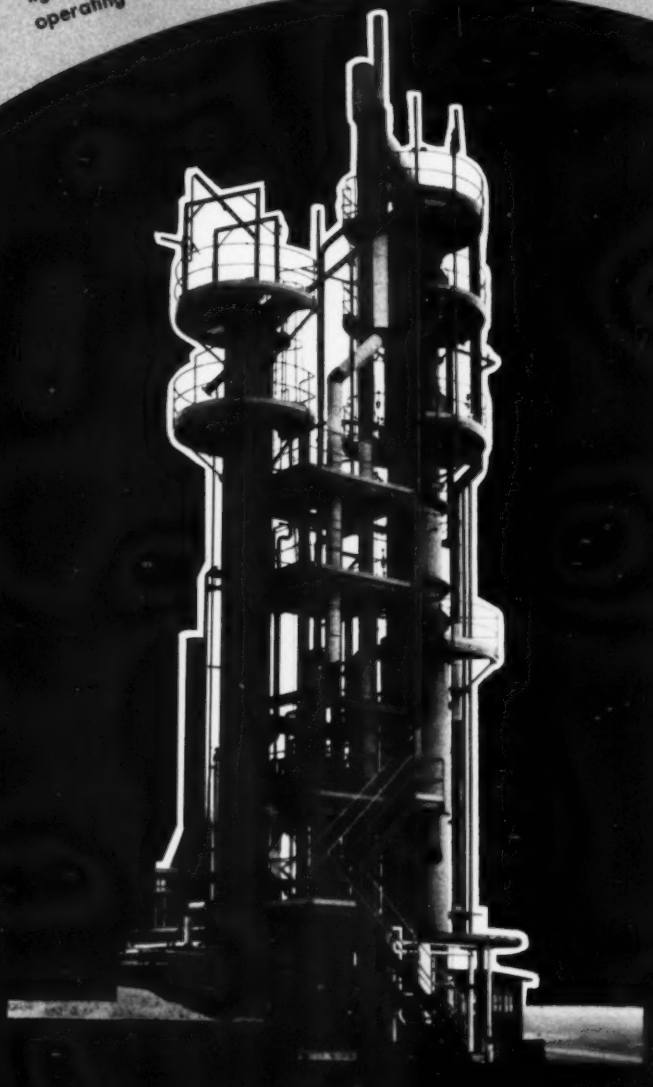


Fig. 9—Yield of gasoline plotted against Research octane number for polyforming Mid-Continent naphtha with 30% outside propane-propylene; effect of olefin content of outside gas at 100% total gas circulation

out of the red into the black with hypersorption

the most economic process for the selective separation of light gases . . . higher yields . . . lower investment and operating costs per product unit.



out of the red

This Hypersorption unit is separating Ethylene from a complex gaseous mixture containing but 5.7% Ethylene. Another unit, charging Natural Gas, is "on stream" and two more are being designed for specific gaseous separations. All of these units have been or will be designed by the Union Oil Co. and the Foster Wheeler Corporation.

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FW

hypersorption fundamentals

research ... development

the temperature control of the tremendous adsorption surface of a moving bed of activated carbon is the basic research-development accomplishment responsible for the highly selective adsorption capacity of the Hypersorption process.

50,000 magnification of the surface of activated carbon.

design
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fabrication
construction

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FLOW DIAGRAM
HYPERSORBER UNIT
FOR

[redacted]

DRAWN BY: V.S. Logan 1-29-46 | SCALE: — = 1'-0" | EST. NO. | RC-392 | DWG. NO. 392-11-P11D

estimate can be accomplished by combining a calculation from Fig. 10 with one from a simplified yield-octane correlation for self-contained naphtha polyforming presented in an earlier publication[1]. The latter correlation is a nomograph which relates the yield and octane improvement from polyforming of virgin naphthas to the characterization factor and motor octane number of the naphtha charge.

Conclusion

The present accent on increased crude runs and maximum gasoline production in refining operations has magnified the importance of maintaining all processing equipment at full charge capacity. It is particularly important to load the units fully with charge stocks which will produce a maximum yield of valuable products. Changes in volume and type of crude charge, in market demands for the various products, in product specifications, and in related plant operations, as well as unit shutdowns, all combine to hamper the economical operation of an individual piece of refinery equipment.

The flexibility of a Polyform unit in charging any of a number of refinery streams interchangeably tends to minimize the difficulties which seriously affect the economics of plant operation. A Polyform unit with only minor operational changes

TABLE 6—Polyforming of Mid-Continent Naphtha with Outside Propane-Propylene

Effect of Olefin Content of Outside Gas at 100% Total Gas Circulation

Outside Gas	None	—30% Propane-Propylene—		
Amount of Propylene, mol % of outside gas		40	60	75
Yields, vol. % of naphtha charge				
Gasoline (10 R.V.P., 400° F. E.P.)	74.7	77.6	80.7	82.0
Gas (C_2 and Lighter), F.O.E.	13.0	13.0	13.0	13.0
Propane-Propylene	2.2	27.5	21.6	14.5
Tar	8.4	10.4	10.4	10.4
Octane Numbers of Gasoline				
Motor, clear	76.0	76.0	76.0	76.0
Research, clear	87.2	86.6	86.7	87.0
Research, +3 cc. T.E.L.	94.4	94.6	94.6	95.0
Gasoline Yield from Outside Gas, vol. % of gas charge		10	20	24
Outside Gas Converted, vol. % of gas charge		16	35	59
Gasoline Yield from Converted Gas, vol. % of gas converted		62	57	41

TABLE 7—Polyforming of Mid-Continent Naphtha with Outside Propane-Propylene

Effect of Olefin Content of Outside Gas

Outside Gas	None	——Propane-Propylene——		
Amount of Gas, vol. % of naphtha charge		30	30	30
Olefin Content of Gas, vol. %		40	60	75
Gas Circulation, vol. % of naphtha charge	100	100	100	100
Operating Conditions				
Furnace Outlet Temperature, °F.	1095	1085	1085	1085
Furnace Pressure, lbs./sq. in.	1500	1500	1500	1500
Yields, vol. % of naphtha charge				
Gasoline, (10 R.V.P., 400° F. E.P.)	73.7	77.4	80.7	80.4
Excess Butane-Butene	0.6	1.0	0.6	3.1
Propane-Propylene	2.6	27.8	21.6	14.5
Gas (C_2 and Lighter), F.O.E.	13.3	12.3	13.6	14.3
Tar	8.9	9.4	9.8	10.7
Inspections	**Charge Stock**	——10 R.V.P. Gasoline——		
Gravity, ° A.P.I.	50.0	54.8	54.0	54.8	54.9
Bromine Number		63	59	59	60
Aniline Point, ° F.		69	72	72	70
Characterization Factor	11.88				
A.S.T.M. Distillation, °F. (D86-46)					
I.B.P.	198	94	100	99	97
10%	284	121	129	130	128
50%	338	245	250	246	243
90%	385	364	366	364	363
E.P.	418	394	398	404	400
Octane Numbers					
Motor, clear	33.8	76.4	76.3	75.9	76.6
Motor, +1 cc. T.E.L.		80.4	80.9	79.5	81.1
Motor, +3 cc. T.E.L.		83.3	84.0	84.0	84.2
Research, clear		87.7	85.9	86.8	87.9
Research, +1 cc. T.E.L.		92.4	92.0	92.5	93.2
Research, +3 cc. T.E.L.		94.8	95.1	95.4	95.2

TABLE 8—Polyforming of Several Naphthas with Outside Gas

Naphtha Charge	—Mid-Continent—		—Eastern Venezuela—		Desulfurized ——West Texas——		——Ordovician——	
Outside Gas		Propane-Propylene		Propane-Propylene		Propane-Propylene		Propane-Propylene
Amount of Gas, Vol. % of Naphtha Charge	None	30	None	30	None	30	None	30
Olefin Content of Gas, Vol. %		60		60		60		60
Gas Circulation, Vol. % of Naphtha Charge	100	100	100	100	100	100	100	100
Operating Conditions								
Furnace Outlet Temperature, ° F.	1095	1085	1090	1085	1095	1090	1100	1090
Furnace Pressure, lbs./sq. in.	1500	1500	1500	1500	1500	1500	1500	1500
Inspections of Charge Stocks								
Naphtha								
Gravity, ° A.P.I.	50.0	Same	46.6	Same	51.8	Same	58.2	Same
Characterization Factor	11.88		11.67		11.84		12.10	
A.S.T.M. Distillation, ° F. (D86-46)								
I.B.P.	198		296		245		183	
10%	284		311		266		220	
50%	338		337		296		272	
90%	385		373		361		358	
E. P.	418		401		416		428	
Octane Numbers, Motor, clear	33.8		43.8		43.3		27.7	
Yields, vol. % of naphtha charge								
Gasoline (10 R.V.P., 400 ° F. E.P.)	73.7	80.7	76.5	83.5	78.9	82.7	72.7	85.7
Butane-Butene (Excess or Deficiency)	0.6	0.6	1.4	1.1	1.9	2.5	—0.1	—1.7
Propane-Propylene	2.6	21.6	1.3	19.9	1.7	20.5	5.3	24.1
Gas (C_2 and Lighter), F.O.E.	13.3	13.6	12.1	12.2	10.7	12.7	14.5	12.7
Tar	8.9	9.8	7.8	9.8	6.0	6.8	5.5	4.2
Inspections of 10 R.V.P. Gasoline								
Gravity, ° A.P.I.	54.8	54.8	50.8	52.8	55.3	53.8	58.8	58.4
Bromine Number	63	59	59	58	57	60	61	59
Aniline Point, ° F.	69	72	55	59	72	69	75	82
A.S.T.M. Distillation, ° F. (D86-46)								
I.B.P.	94	99	98	94	90	92	92	106
10%	121	130	136	130	134	140	121	142
50%	245	246	291	286	255	256	209	218
90%	364	364	361	368	356	356	325	336
E.P.	394	404	396	400	400	400	402	410
Octane Numbers								
Motor, clear	76.4	75.9	78.2	77.8	75.8	76.3	75.5	73.0
Motor, +1 c.c. T.E.L.	80.4	79.5	82.5	82.4	81.2	81.5	80.0	78.5
Motor, +3 cc. T.E.L.	83.3	84.0	84.7	84.7	83.8	83.4	83.3	82.3
Research, clear	87.7	86.8	90.1	90.0	87.0	87.8	85.5	82.3
Research, +1 cc. T.E.L.	92.4	92.5	94.9	94.3	91.5	91.7	91.3	88.2
Research, +3 cc. T.E.L.	94.8	95.4	97.1	96.6	94.2	94.2	94.3	91.7

can handle with equal ease all virgin or cracked naphthas regardless of properties and a wide range in volume of extraneous C_3 and C_4 fractions from other refinery processes. Highest production of gasoline can be assured, however, by charging a maximum of naphtha and maintaining the olefin content of the circulating gas at a high level. The circulating gas can be enriched in olefins advantageously with C_3 and C_4 fractions produced as a byproduct of catalytic cracking. Naphtha charge can also be supplemented with catalytic furnace oil[3] when available.

The flexibility of a naphtha polyforming operation is also useful in maintaining a refinery butane balance during variations in seasonal demands and in production schedules of other units. Extraneous butane-butene may be charged to a naphtha polyforming unit to increase the production of gasoline from the circulating gas without increasing the total gas recycle. During periods of butane-butene deficiency for alkylation or vapor pressure requirements, an excess yield of olefinic butane-butene may be produced from the Polyform unit by simple changes in the operation of the stabilizer and absorber.

The high level of laboratory octane ratings and sensitivity of gasolines from the Polyform process has been apparent in the foregoing tables. Road performance of these gasolines also indicates good quality at all engine speeds. Earlier literature[4] has shown Polyform gasolines possess desirable blending properties due to their balanced volatility and favorable distribution of hydrocarbon types throughout the boiling range.

References

(1) W. C. Offutt, P. Ostergaard, M. C. Fogle, and H. Beuther, "Naphtha Polyforming", presented at the Group Session on Refining of the 26th annual meeting of the American Petroleum Institute (1946), PETROLEUM PROCESSING, December, 1946. p. 267.

(2) W. C. Offutt, P. Ostergaard, M. C. Fogle, and H. Beuther, "Naphtha Polyforming with Outside Gas", presented at the Group Session on Refining of the 26th annual meeting of the American Petroleum Institute (1946), PETROLEUM PROCESSING, December, 1946, p. 278.

(3) W. C. Offutt, P. Ostergaard, M. C. Fogle, and H. Beuther, "Gas Oil Polyforming", presented before the 45th annual meeting of the National Petroleum Association, September, 1947, PETROLEUM PROCESSING, October, 1947, p. 753.

(4) W. C. Offutt, M. C. Fogle, and H. Beuther, "Physical Properties and Characteristics of Polyform Distillate", presented before the 112th national meeting of the American Chemical Society, September, 1947.

CORRELATION CHART ON POLYFORMING OF MID-CONTINENT NAPHTHA

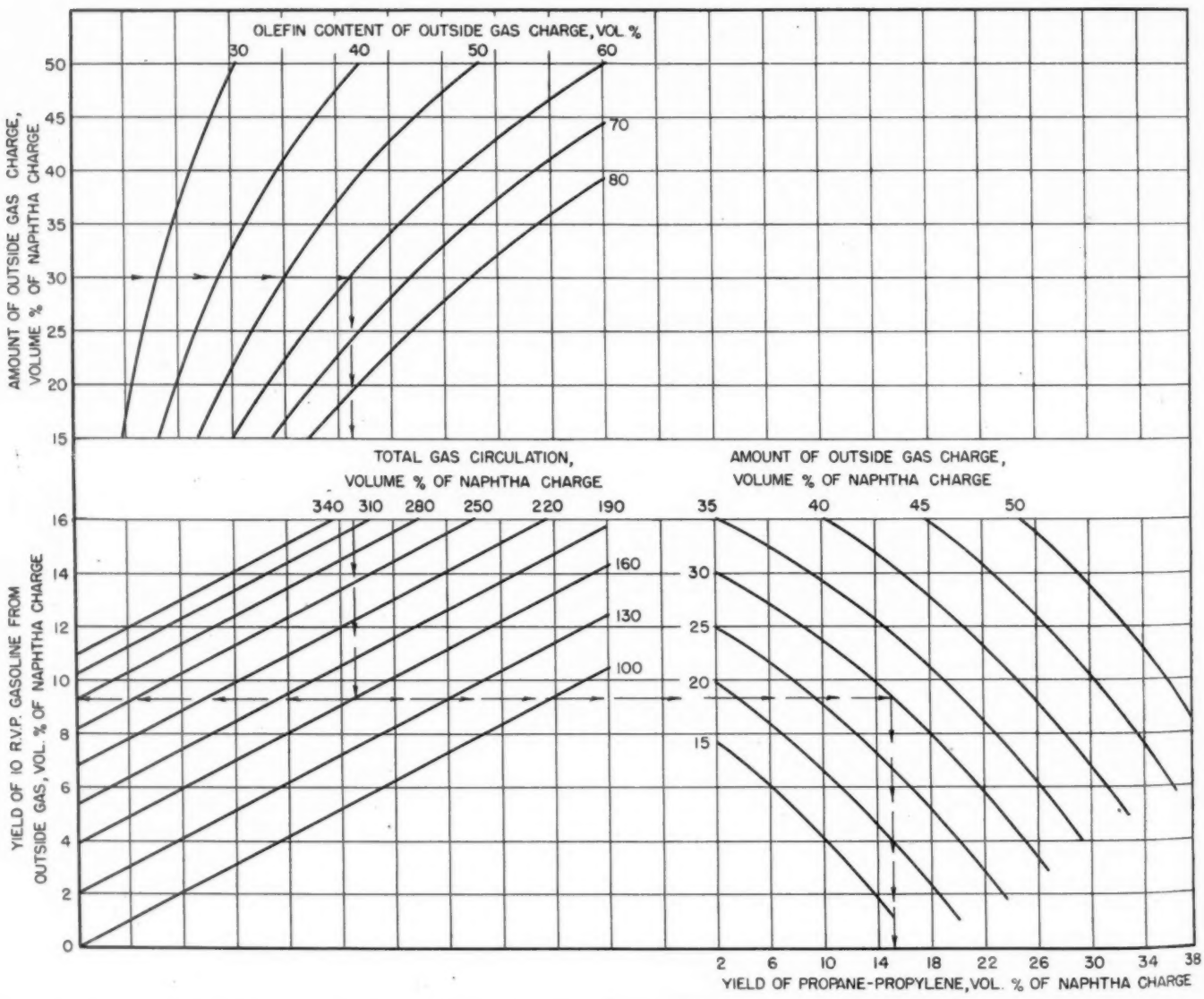
OLEFIN CONTENT OF OUTSIDE GAS CHARGE, VOL. %
30
40
50
60
70
80
AMOUNT OF OUTSIDE GAS CHARGE, VOLUME % OF NAPHTHA CHARGE
TOTAL GAS CIRCULATION, VOLUME % OF NAPHTHA CHARGE
340 310 280 250 220 190
160
130
100
YIELD OF 10 R.V.P. GASOLINE FROM OUTSIDE GAS, VOL. % OF NAPHTHA CHARGE
AMOUNT OF OUTSIDE GAS CHARGE, VOLUME % OF NAPHTHA CHARGE
35 40 45 50
30
25
20
15
2 6 10 14 18 22 26 30 34 38
YIELD OF PROPANE-PROPYLENE, VOL. % OF NAPHTHA CHARGE

Fig. 10—Correlation of yields from outside propane-propylene; polyforming of Mid-Continent naphtha-74-77 Motor octane gasoline

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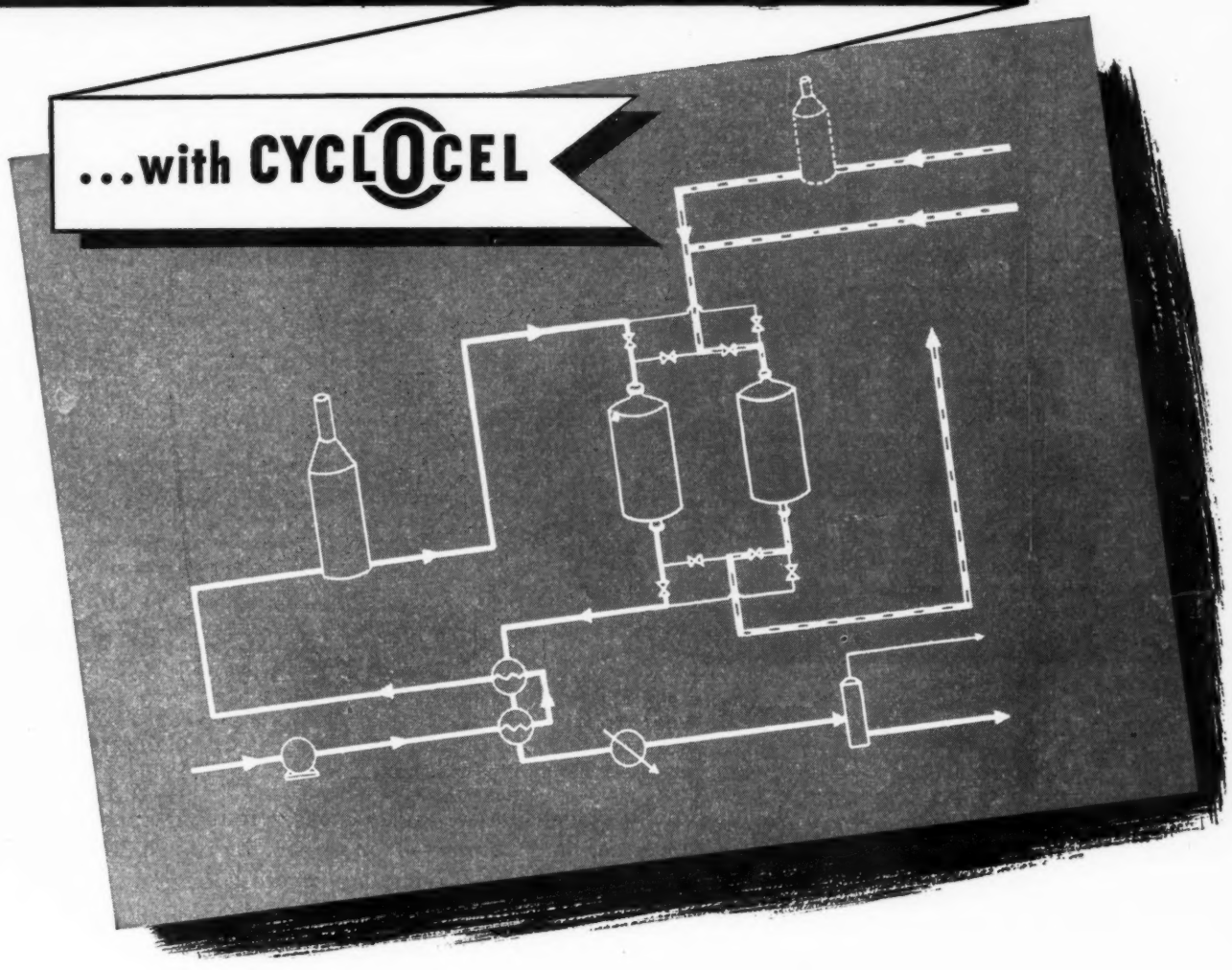

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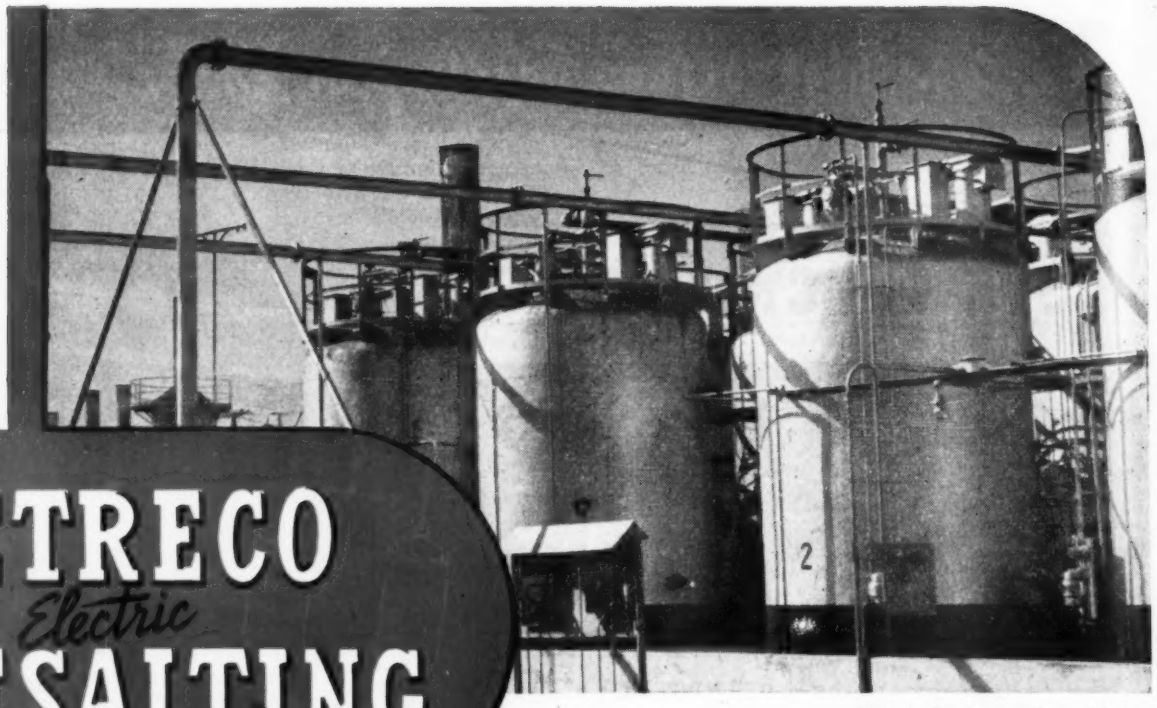

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PR 48-1

Modified Extreme Pressure Lubricant Tester Gives Preliminary Evaluation of Gear Lubes

By E. C. EASTMAN, D. W. DINSMORE, K. L. GODFREY and E. S. BLAKE
Monsanto Chemical Co., Nitro, W. Va.

A useful and convenient test, carried out on a suitably modified SAE Extreme Pressure Lubricant Testing Machine, has been developed for the prediction of the CRC L-20-545 high torque and low speed performance characteristics of gear lubricants. Besides serving as a preliminary screening test the method is relatively rapid and simple, and requires only a small oil sample. Although test results depend primarily upon the visual inspection of the test cups, satisfactory correlation has been obtained between the laboratory test and the CRC L-20-545 test.

RECOGNITION by the Ordnance Department of the need for a Universal Gear Oil Specification which would more nearly define a satisfactory lubricant under field operating conditions in all types of automotive gear drives led, through the efforts of the Coordinating Lubricants Research Committee, to the formulation and adoption of U. S. Army Specification 2-105B.

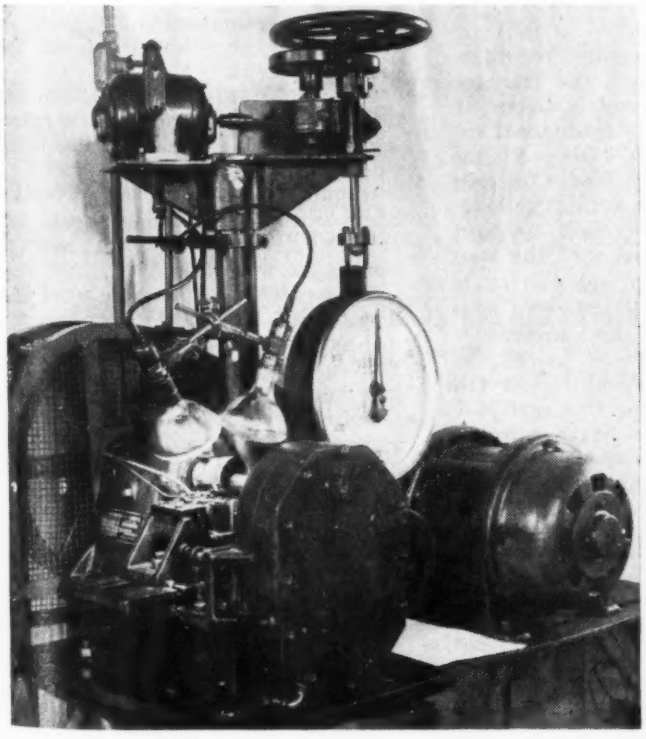
Qualification for procurement under Specification 2-105B requires, among other tests, that the Universal Gear Lubricant pass the Ordnance Department Specification AXS-1570 (CRC Designation L-20-545) for the high torque and low speed axle test. Because of the elaborate and expensive L-20 equipment required, the need for a preliminary screening test was apparent.

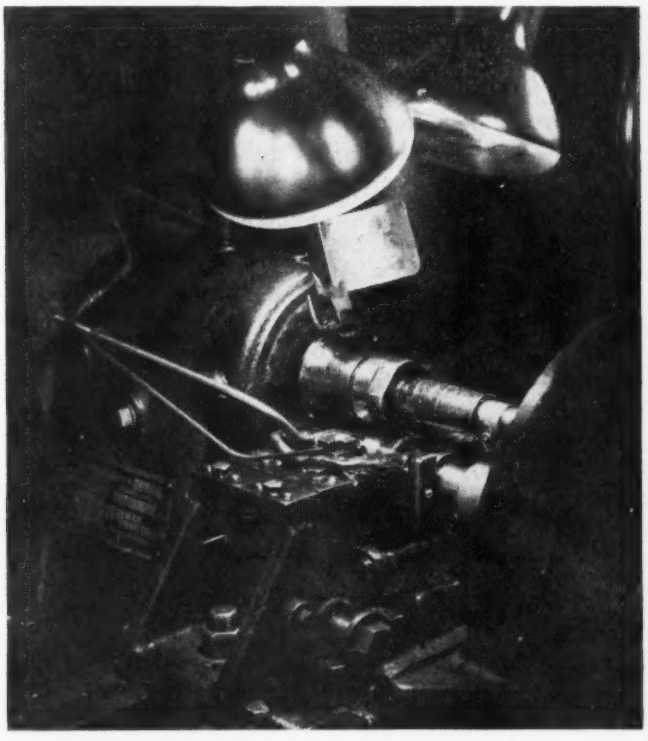
The purpose of this paper is to describe a test which has proved to be a useful research tool in the development of suitable 2-105B gear oil additives by predicting lubricant behavior under L-20 high torque and low speed conditions. Other advantages are: Economy, small size of oil sample, minimum demand on the operator's time, reasonable reproducibility of tests and simplicity of operation.

Apparatus

The machine employed for this test is an SAE Extreme Pressure Lubricant Testing Machine as manufactured by the Highway Trailer Co., Edgerton, Wis. This machine, suitably modified (Figs. 1 and 2), provides a readily available means of imitating the rubbing of gear teeth by rotating two Timken test cups (T-48651) in line contact with each other and in opposite directions, under controlled speed, slipping velocity, temperature and operating pressure. Necessary modifications are achieved by:

1. Reducing the main shaft speed





Figs. 1 and 2—General and closeup views of a modified SAE Extreme Pressure Lubricant Testing Machine as used for evaluating gear lubes

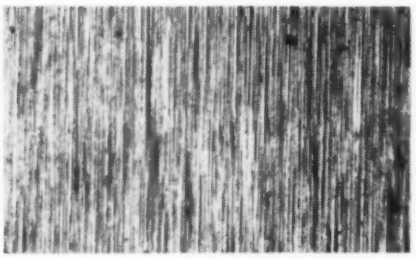


Fig. 3—Original surface (30X)

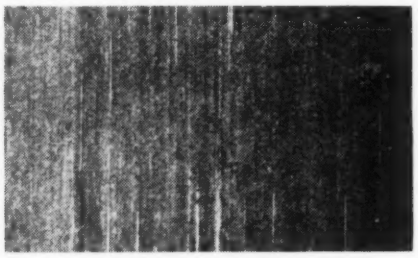


Fig. 4—Smoothing (30X)

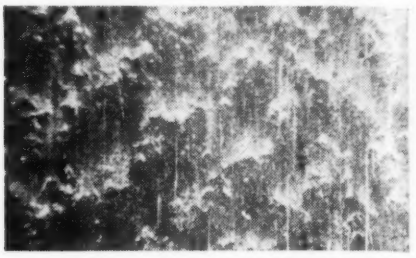


Fig. 5—Rippling (30X)

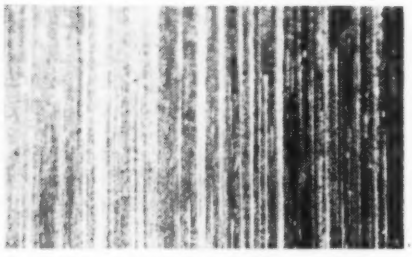


Fig. 6—Ridging (30X)

Fig. 7—Pitting (30X)

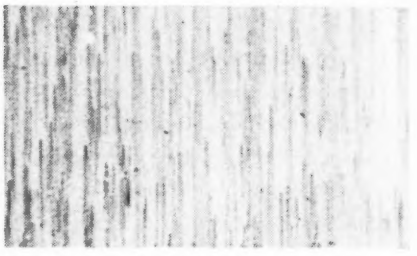


Fig. 8—Galling (30X)

from the standard 1000 to 264 RPM.

2. Replacing the lower shaft drive gears of 20 and 81 teeth with gears of 52 and 49 teeth to change the rubbing ratio from 14.6/1 to 3.4/1.

3. Jacketing the oil box on both bearing sides by brazing a plate over the offset in the oil box casting. Both cooling reservoirs are then connected in series to a water coolant source.

4. Fitting the bearing shaft on both sides of the oil box with oil retainer gaskets.

5. Replacing the standard steel bearings with special bronze bearings.

6. Installing a thermocouple in the test oil such that the junction is 1/4 in. below the bottom test cup.

7. Installing a temperature recorder-regulator to be actuated by the thermocouple.

8. Installing a solenoid controlled cooling water valve actuated between limits by the temperature regulator.

9. Mounting two 200 watt infra red drying lamps focused into the oil box and actuated by the temperature regulator.

10. Installing a shield over the test cups to prevent direct heating of the cups.

Supplementary apparatus, comprising an analytical balance and a wide field binocular microscope with magnification from 10.5X to 30X, is required.

Two Timken test cups which have been freshly cleaned with solvent and dried are weighed to the nearest milligram and fastened in place on their respective shafts. The oil box is positioned in the carriage with knife edges in place; the thermocouple junction is adjusted to 1/4-in. below the lower cup; the plate holding the oil seal is tightened; the coupling links are inserted on the upper and lower shafts, and the oil box locked into position.

A 20-lb. scale load is applied by hand and the cup alignment checked for perfect contacting edges and adjusted if necessary. The 20-lb. load is released and the water lines are connected.

The oil to be tested is then added until the lower test cup is half immersed. This oil level is maintained for the duration of the run by adding more oil when necessary. The oil box bearings are lubricated with the oil to be tested.

With the temperature recorder-regulator in operation, the machine is started and the load is taken up to 50 lbs., where it is maintained for a break-in run of 1/2 hr. At the end of the break-in the load is brought up to 110 lbs. by the automatic loading device where it is held constant for 15 hrs., the duration of the test.

The temperature of the test oil is cycled between 200°-250° F. over a 15-min. period, by the temperature regulator. Immediately after the application of the 110-lb. load the rate of coolant water flow and the distance of the two heating lamps from the oil box are adjusted to obtain a smooth symmetrical heating and cooling curve as drawn by the recorder.

Inspection

Upon completion of the test, the test cups are cleaned and reweighed to the nearest milligram for total weight loss, then inspected microscopically, oiled and filed for future reference. The rating of the completed test depends primarily upon the visual inspection of the test cups, which requires some training for the proper identification and rating of surface conditions. In most instances the bottom ring shows more surface disturbance than does the top ring, a phenomenon for which there are several theoretical explanations.

The inspection terminology used in describing the ring surface is essentially that given in the CRC Designation L-20-545, namely: (a) burnish, (b) smoothing, (c) rippling, (d) ridging, (e) pitting and (f) galling.

Burnish is an alteration from the original ground dull surface (Fig. 3) to a brightly polished surface and is usually accompanied by some alteration in or elimination of the grinding marks.

Smoothing (Fig. 4) is the elimination or near elimination of the grinding marks where the surface finish usually remains dull.

Rippling (Fig. 5) is the formation of transverse surface patterns, dull or shiny, resembling fish scales or ripples on water.

Ridging (Fig. 6) as here used is a longitudinal furrowing or channeling as a result of a wearing force. This is actually a misnomer as grooving would be a more accurate descriptive term. Frequently rippling appears in the base of the groove indicating this may have been the precursor of grooving or ridging.

Pitting (Fig. 7) is the formation of small pit-like cavities.

Galling (Fig. 8) is difficult to describe but as used here it means a surface alteration which appears to be a lengthening, widening, deepening and blackening of individual grinder marks. This may be due to localized chemical attack.

For comparative purposes a picture of a cup surface representing a good pass is included (Fig. 9). Also shown

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CHEMICAL COMPOSITION:

(a) The castings shall conform to the following requirements as to chemical composition:

	GRADE "F"
Chromium, per cent	25.0-28.0
Nickel, per cent	10.0-12.0
Manganese, per cent	0.50-1.25
Silicon, per cent	0.25-1.75
Sulphur, maximum per cent	0.05
Phosphorous, maximum per cent	0.05
Carbon	Within limits of Paragraph 4 (c)

(b) The chemical limits for all other added alloying elements, such as molybdenum, titanium and nitrogen, shall be specified by the manufacturer. The material shall conform therewith.

CREEP STRESS AND CERTIFICATE:

(a) The indicated creep rate of the material shall not exceed 1% in 10,000 hours when stressed by a tensile load not less than the following:

TEMP. °F.	STRESS PER SQ. IN. 1% CREEP IN 10,000 HOURS GRADE "F"
1400°	4200#
1500°	3700#
1600°	3200#
1700°	2600#
1800°	1950#

(b) Manufacturer shall submit standard creep data and residual physical properties made on material of his own manufacture and certified by an ACCREDITED LABORATORY. The chemical analysis of the creep test specimens shall be reported, including nitrogen content and any other special alloying elements.

TENSION TEST FOR DUCTILITY AFTER HEATING:

(a) Each heat shall conform to the following requirements as to tensile properties after the specimen has been subjected to a temperature of 1400° F. for 24 hours and furnace cooled to 400° F. Test shall be made at room temperature.

	GRADE "F"
Tensile Strength, min.lb./sq.in.	80,000
Yield Strength, min.lb./sq.in.	35,000
Elongation in 2", min. per cent	9.0

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Fig. 9—Typical cup surface representing a good pass (30X)

TABLE I
Laboratory Test Results vs. CRC L-20-545 Rating

Test No.	Ridging	Rippling	Burnish	Smoothing	Pitting	Galling	Ridging	Rippling	Burnish	Smoothing	Pitting	Galling	Wt. Loss, Mg. Top	Wt. Loss, Mg. Btm.	Laboratory Rating		CRC L-20-545 Rating
1	H	L	M	H	O	O	H	L	M	H	O	O	50	103	Fail		Fail
2	O	O	L	T	O	O	O	O	O	L	O	O	5	14	Pass		Pass
3	O	T	O	O	O	O	T	L	O	H	O	O	4	16	Pass		Pass
3A	O	T	O	L	O	O	O	T	O	L	O	O	4	8	Pass		
4	O	T	T	L	T	O	I	T	T	L	O	O	5	8	Pass		
4A	T	T	O	T	O	L	T	T	O	H	O	L	9	25	Fail	BL Pass	Pass
4B	O	T	O	T	O	O	O	T	O	H	O	O	6	21	Pass		
5	O	T	O	T	O	O	O	T	O	L	O	O	3	9	Pass	Pass	Pass
5A	O	T	O	L	O	O	O	T	O	L	O	O	4	8	Pass		
6	I	T	O	T	O	O	L	T	O	M	O	O	3	10	Fail		Pass
7	O	O	O	T	O	O	T	T	O	L	O	O	6	16	Pass		Pass
8	O	O	L	T	O	O	O	O	L	L	O	O	5	12	Pass		Pass
9	T	O	O	T	O	O	O	O	O	H	O	O	7	12	Pass	BL Fail	Fail
9A	T	O	T	L	T	O	T	O	O	M	T	L	12	18	Fail		
10	O	T	T	T	O	O	O	O	O	M	O	T	4	12	BL Pass	Fail	Fail
10A	I	O	O	T	O	L	O	T	O	H	O	L	12	12	Fail		
11	I	T	O	L	O	O	I	L	L	L	O	O	4	4	BL Pass		Pass
12	O	T	O	L	O	O	O	T	O	T	O	O	3	6	Pass		Pass
13	O	O	T	L	O	O	I	T	L	M	O	O	3	11	Pass		Pass
14	O	O	O	L	O	O	T	T	T	M	O	T	4	10	BL Pass	Pass	Pass
14A	O	O	O	L	O	T	O	O	T	L	O	O	4	9	Pass		

H, heavy; I, incipient; L, light; M, medium; O, none; T, trace.

are two pictures of pinion gear teeth from two L-20 high torque and low speed tests. Fig. 10 is a typical pass. Fig. 11 depicts a fail showing both rippling and ridging.

Rating

In the initial orientation, rating is the direct result of L-20 correlation. The development of the proper visual technique in an overall appraisal of the test specimens is important in the final classification as an L-20 pass or fail. Such an overall appraisal inherently does not lend itself to a precise definition as to what shall or shall not be present in the surface conditions. Obviously, this skill can be acquired only by a study of a back-log of samples upon which the L-20 results are known. Notwithstanding, from the individual ring ratings coupled with experience, the test is usually graded as a pass or a fail with two intermediate classifications, borderline pass or borderline fail. Perhaps a pass of merit should be included.

A passing test rarely shows a total weight loss of more than 20 mg. and no light ridging. It may, however, show an incipient, or trace of, ridging, slight burnish, smoothing and rippling. A borderline pass is one showing slightly more surface disturbance than a pass with perhaps an allowable surface condition called incipient ridging provided the weight loss is low. The total weight loss of a borderline pass also seldom exceeds 20 mg.

A test rated a fail may show a weight loss of appreciably less than 20 mg., although the weight loss usually exceeds that figure. In this classification all of the described surface disturbance conditions may appear, and usually do in the more severe failures. The surfaces of the test cups usually show some degree of ridging which appears to be indigenous to a test failure. Obviously, then, a ring condition less severe than a fail and more severe than a borderline pass is a borderline failure, the classification of which is readily recognized with experience.

A tabulation (Table 1) of surface conditions is useful for reference purposes, but for the comparative rating of specific lubricants it does not serve as a complete substitute for direct visual comparison of the specific test rings.

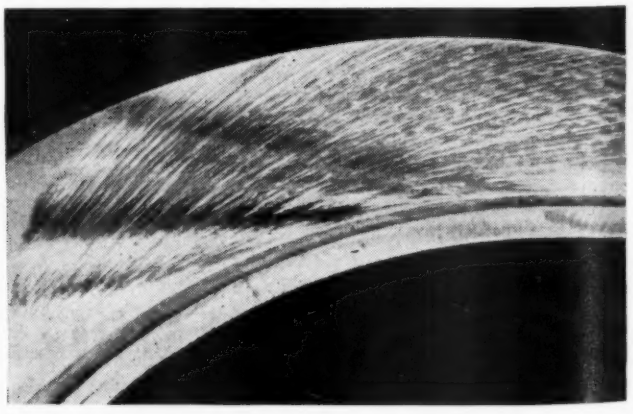
Correlation

Satisfactory correlation between the laboratory test and the CRC L-20-545 test is clearly illustrated by Table 1. With the exception of Test No. 9A, the laboratory tests were completed and rated without prior knowledge of the L-20 performance results.

Although the major portion of the L-20 runs were predicted on the basis of single laboratory runs, the inadvisability of this practice is recognized. For example, from the Laboratory Test No. 9 the L-20 test was predicted as a pass and actually was a fail. Test No. 9 was later re-run as Test No. 9A, which confirmed this failure.

Acknowledgement

The authors acknowledge with pleasure the able guidance of J. P. Stewart in this conversion and application of the S.A.E. Extreme Pressure Lubricant Testing Machine.



Figs. 10 and 11—Pinion gear teeth from two L-20 high torque and low speed tests. Fig. 10 is a typical pass; Fig. 11 a failure (approx. 2X)

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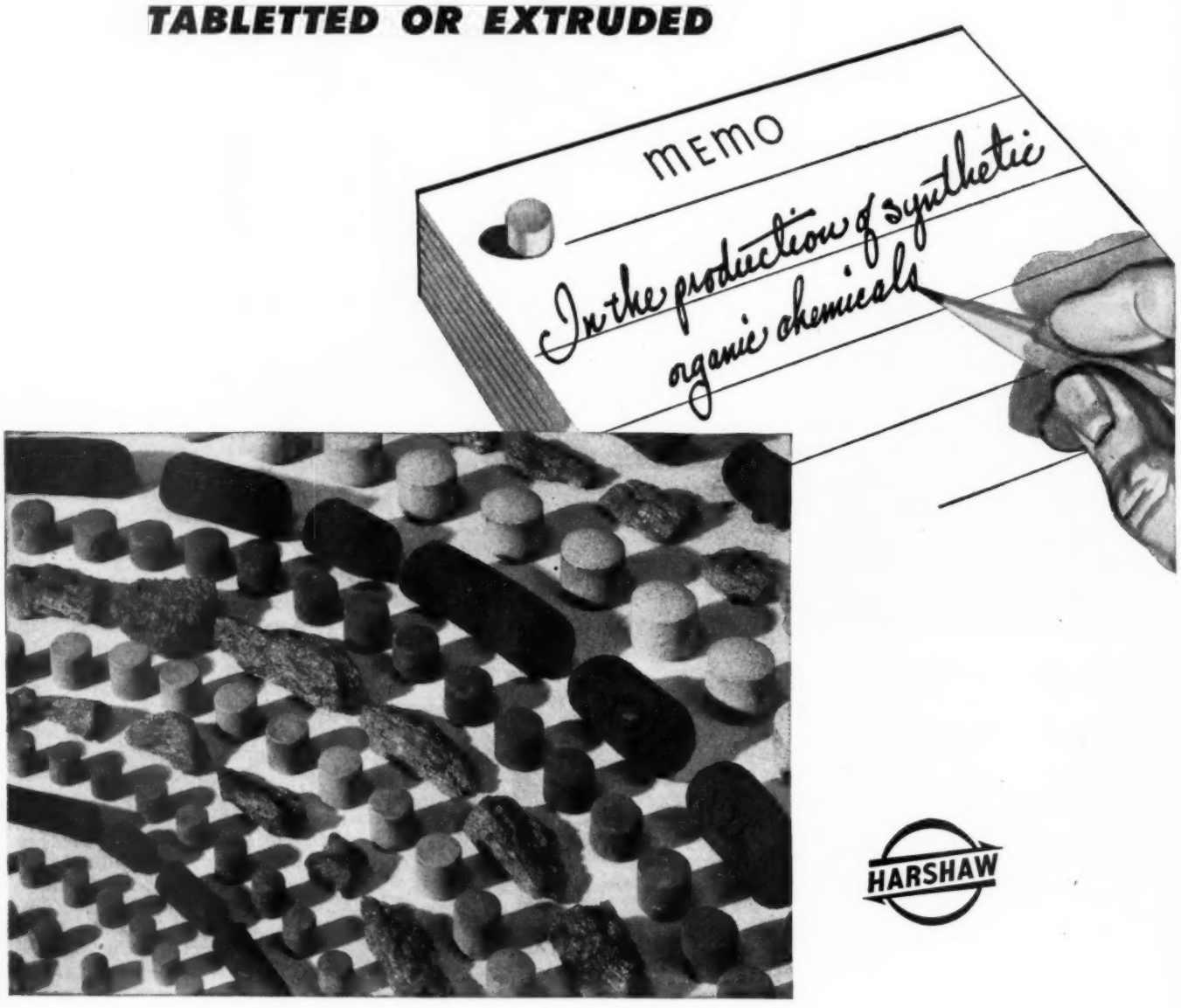

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Patent Trends in Petroleum Refining

By PETER J. GAYLOR

Patent Attorney and Editor "The Technical Survey"

Polyoxypropylene Compounds As Synthetic Lubricants

IN ONE OF OUR EARLIER discussions(1) we mentioned the Carbide Brit. Pat. Appl. 25,614/45, which disclosed production of synthetic lubricating oils by condensing a monohydric alcohol with 1,2-propylene oxide. Recently, U. S. Patent 2,448,664 was issued to Carbide and Carbon Chemicals Corp., giving additional data on these materials.

It is pointed out that although addition products of ethylene oxide have been suggested for use as lubricants, their high melting or solidification temperatures make them unsuitable for use as metal lubricants where fluidity over a wide range of temperatures is required. Apparently there are no satisfactory solvents which will retain the polyoxyethylene compounds in solution at the lower range of temperatures down to −40° F., to which they may be subjected in service. In textile lubrication, where they may be used in aqueous solution, there is a tendency for the diluent and the solid component to separate to such an extent as to interfere with proper lubrication.

According to the patent, polyoxyalkylene compositions which are preponderantly monohydroxy alcohols of relatively high molecular weight may be obtained by the addition of a monohydroxy aliphatic alcohol to 1,2-propylene oxide, according to the reaction:

$$\underset{\text{monohydric alcohol}}{ROH} + n\underset{\text{1,2-propylene oxide}}{(OC_2H_3{\cdot}CH_3)} \rightarrow \underset{\substack{\text{polyoxypropylene}\\ \text{monohydroxy compound}}}{R(OC_2H_3{\cdot}CH_3)_nOH}$$

These addition products contain an average of at least eight oxy-1,2-propylene oxide groups in the molecule, and have unusual properties of solubility, viscosity, stability and lubricating ability.

For example, these 1,2-polyoxypropylene monohydroxy compounds have unusual temperature-viscosity relationships. All of the products have a viscosity above 3cs. at 210° F, and they do not solidify on cooling to −20° F. As can be seen from Fig. 1, they can be distinguished from mineral oils in that the slope of their viscosity-temperature curve is, in general, less than the slope of the same curve for mineral oils. The rate of change of viscosity with temperature for these products is not as great as in the case of mineral oils.

In general, the ratio of viscosity in centistokes at 100° F. to the viscosity at 210° F. is below 8.0. Their viscosity is some exponential function of their average molecular weight. At molecular weights below 2000, all of the addition products appear to have viscosities below 50 cs./210° F., and products having molecular weights of 2000-3000 are liquids in contrast to the polyoxyethylene compounds which are solids.

One surprising characteristic is their thermochemical stability at temperatures of 500° F. Also, they do not affect rubber hose, which is one of the drawbacks of mineral oils, and they possess good lubricity.

However, these compounds are not very compatible with mineral oils.

TABLE 1—Compatibility of Polyoxypropylene Compounds with Mineral Oil

Alcohol Reacted	Miscibility Temperature, °C. Methanol	Butanol	7-Ethyl-2-Methyl undecanol-4
Average Molecular Weight:			
600	73	48	5
800	80	60	25
1,000	87	74	45
1,200	93	88	60
1,400	100	103	75
1,600	110	118	87

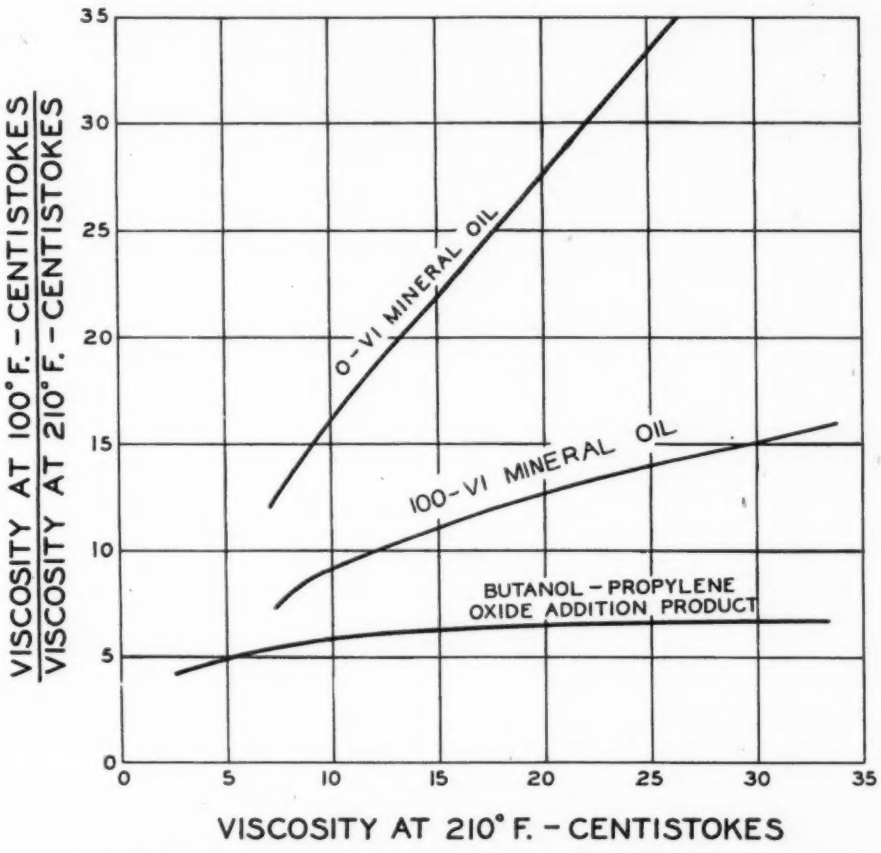

Fig. 1—Comparison of viscosity characteristics of mineral oils and a typical polyoxypropylene compound (U. S. Patent 2,448,664, Carbide and Carbon Chemicals Corp.)

Their oil miscibility is a function of both the molecular weight and the number of carbon atoms in the added alcohol, as shown by the data given in Table 1. In other words, the methanol addition product of 600 molecular weight will separate from the oil at 73° C., while the 7-ethyl-2-methyl unde-canol-4 product of the same molecular weight will separate out at 5° C. The oil employed in determining these solubilities is a highly refined paraffinic type having a viscosity of 10.73 cs./210° F., and a refractive index of 1.48 13/20° C.

On textile fibers, these oils produce a high quality lubrication and finish without a sulfonation step and without the usual "oiliness" agents. As to pour points, the methanol addition products vary according to molecular weight as follows:

Acetyl Molecular Weight	Pour Point, °F.
1625	—39.5
1418	—43
907	—72.4
530	—76

Cation Exchange Materials From Spent Alkylation Acid

BASE EXCHANGE MATERIALS have acquired importance in recent years, and an increasingly large volume of resins is being produced for cation exchange purposes.

According to U. S. Patent 2,447,762 issued to Atlantic Refining Co., a cheap cation exchange adsorbent may be produced by heat treating spent alkylation acid, preferably one containing a minimum of 10% of hydrocarbon and having an acid concentration, on a hydrocarbon-free basis, of 98%.

This spent acid is heated for about 4 hrs. at 290-340° F. to obtain gelation into a hard granular solid. Excess acid is removed by water washing and the product is dried at 212° F. for 13 hrs. If desired, it may be neutralized with sodium bicarbonate prior to drying. One sample of unneutralized product showed an exchange capacity of 6 kg/cf as $CaCO_3$, while the neutralized product showed a value of 10 (on a wet basis). Such a product would be useful in removing hardness from water and metallic ions from industrial effluents.

According to Berl[2] an active carbon may be obtained by neutralizing acid sludge and coking at 1100° C., but the above Atlantic patent points out that products such as these contain soluble or peptizable bodies, as mentioned by Burrell.[3] The Berl product is said to compare favorably with sulfonated coal adsorbents.

References
(1) Gaylor, PETROLEUM PROCESSING, 11/46, p.186.
(2) Berl, U.S. 1,812,316 (Also see 1,851,888) Berl, *Z. Angew. Chem.* 4/9/30 p.330.
(3) Burrell, *Ind. Engrg. Chem.* 1938, p.358.

Other Recent Patents

Selected recently issued U. S. process patents are briefly reviewed below:

U. S. 2,447,505: Everett A. Johnson, assignor, to S. O. Indiana: Method for regenerating fluidized catalyst in the carbon monoxide-hydrogen synthesis, by centrifugal separation of catalyst in the upper reaction zone, passing the catalyst to the base of the reaction zone and aerating with hydrogen.

U.S. 2,447,573; Otto Gerbes, assignor, to Standard Oil Development Co.: Method for isomerizing paraffins by supplying a mixture of a low molecular weight paraffin feed stock and hydrogen chloride at 230-270° F. to a catalytic mass formed by adsorption of aluminum chloride vapor on a porous support.

U.S. 2,447,746; Seymour W. Ferris, Edward R. Lamson and Douglas M. Smith, assignors to Atlantic Refining Co.: Method for distilling by forming the liquid into a vertical, downward moving, free flowing, unbroken film, having two exposed surfaces each in close proximity to, but out of contact with, a condensing surface in the column, the vaporizing portion of the film being condensed on the condensing surface.

U. S. 2,448,015; Robert E. Burk to S. O. Ohio: Process for cracking kerosine by treating with a liquid catalyst the inorganic constituents of which comprise primarily about 89 vol % of hydrogen fluoride, promoted by boron trifluoride.

U.S. 2,448,092; James D. Gibson, assignor, to Phillips Petroleum Co.: Improvement in the hydrofluoric acid alkylation process which includes principally a dehydrofluorinating distillation step to remove the organic fluorine compounds.

U.S. 2,448,160; Charles L. Thomas and Vladimir Haenzel, assignors, to Universal Oil Products Co.: Process for producing alkylated aromatics by reacting an aromatic with an olefin in the presence of an alkylating catalyst comprising silica, alumina and thoria.

U.S. 2,448,223; Henri Lantz, Paris, assignor to Societe Chimique de la Grande Paroisse, Paris: Continuous low temperature distillation process in which a portion of the distillation products are recycled through a heat exchange zone and introduced into the distillation zone in direct contact with the material to be distilled.

U.S. 2,448,279; Louis C. Rubin, assignor to M. W. Kellogg Co.: A process for hydrogenating carbon oxides which comprises continuously flowing a gaseous mixture of hydrogen and a carbon oxide upward in a catalytic reaction zone; withdrawing a gaseous mixture from which are recovered gasoline and other liquid products.

U.S. 2,448,290; Harold V. Atwell, assignor to The Texas Co.: An improvement in a process for the synthesis of a gaseous hydrocarbon in which additional heat for the reaction is supplied by suspending in the reactant stream a powdered solid heat carrier.

U.S. 2,448,334; Kenneth Merle Watson, assignor, to Sinclair Refining Co.: Improvement in the circulation and regeneration of solid catalyst in the pyrolytic conversion of hydrocarbons.

U.S. 2,448,489; Alfred E. Hirschler, assignor, to Sun Oil Co.: A process for solvent separation of two aromatic hydrocarbons having the same number of double bonds per molecule by passing a mixture through a body of silica gel.

U.S. 2,448,601; Carl S. Kelley, assignor, to Phillips Petroleum Co.: Improvement in the HF alkylation process which includes mainly introducing in the distillation of the effluent a propane-propylene mixture to react with the hydrogen fluoride to form propyl fluoride.

U.S. 2,449,050; George R. Bond, Jr. and George Alexander Mills, assignors, to Houdry Process Corp: The use of a cerium phosphate as the principal catalytically active component in the catalytic conversion of hydrocarbons.

U.S. 2,449,061; Samuel M. Darling, assignor, to S. O. Ohio: Use of a catalyst comprising alumina to which has been added a separately formed metal oxyfluoride of the group consisting of beryllium oxyfluoride, titanium oxyfluoride, and zirconium oxyfluoride as the essential promoter, in the conversion of higher boiling hydrocarbons.

U.S. 2,449,071; Charles O. Hawk, Norma R. Stern and Lawrence J. E. Hofer, assignors, to U.S.A.: Catalyst for the synthesis of liquid and solid hydrocarbons from hydrogen and carbon monoxide consisting essentially of the reduction products of a mixture of precipitated ferric oxides in which from 1 to 60% by weight is in the meta form, the balance being essentially in the ortho form.

U.S. 2,449,095; Harry K. Wheeler, Jr., and Robert J. Hengstebeck, assignors, to S. O. Indiana: In cracking with fluidized catalyst, a method for submitting both the effluent product and gas streams containing residual solids to a series of scrubbing operations with a heavy hydrocarbon oil for recovering solids.

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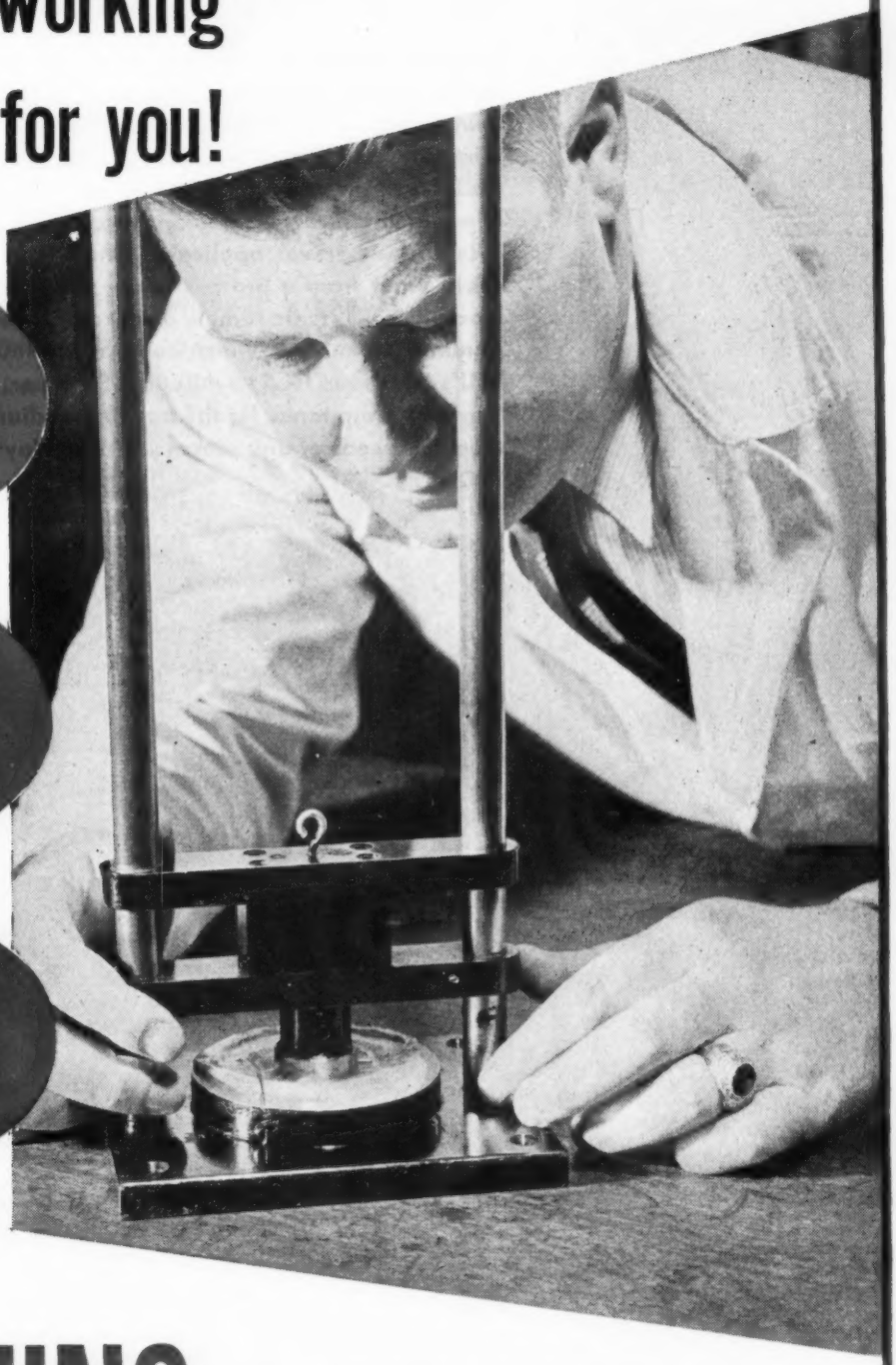

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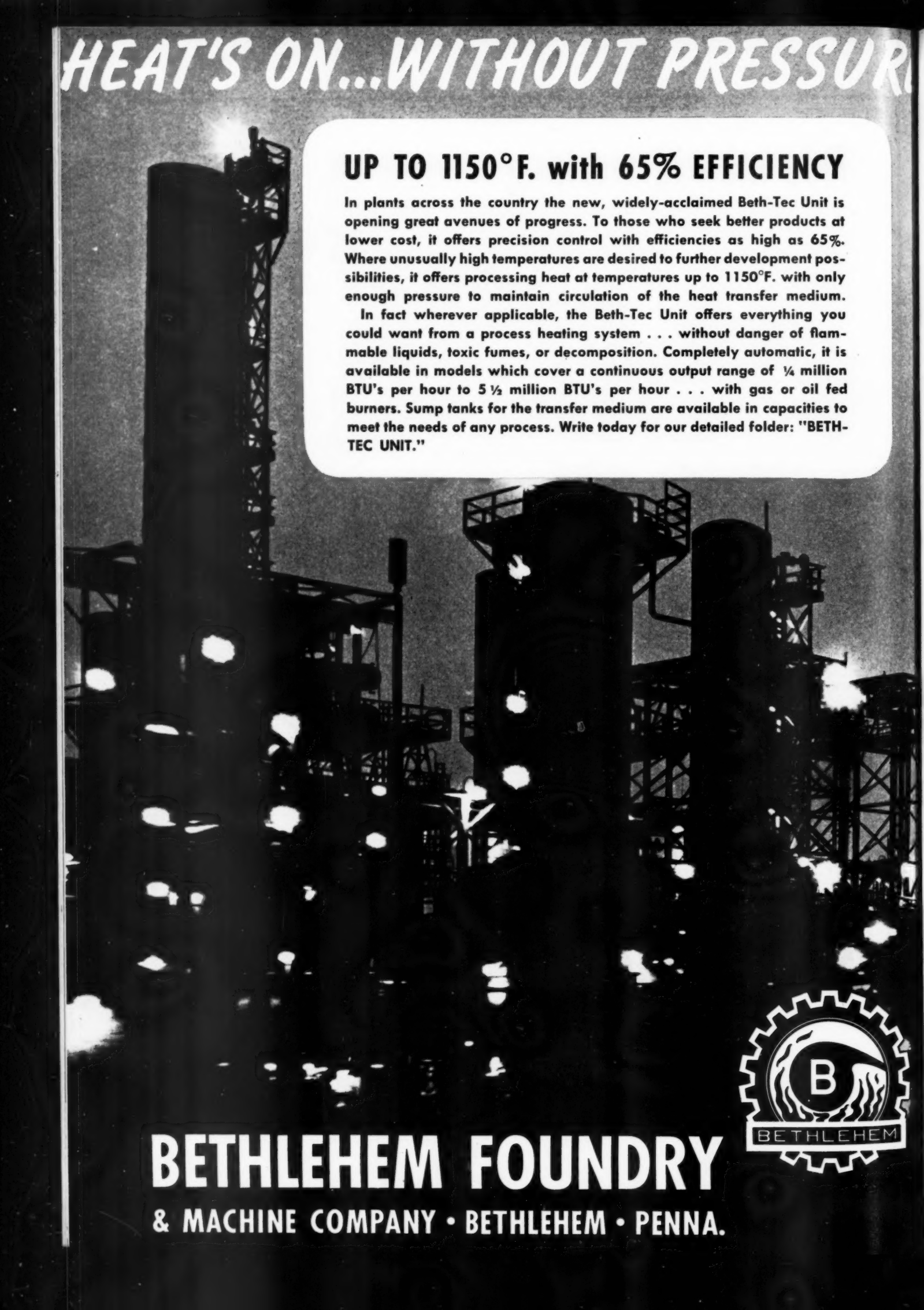
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Orifice Plates Can Be Replaced With Line in Normal Operation

In addition to the removable orifice plates described below, this month's review of new and improved devices used in petroleum processing and handling operations on which patents have been issued recently includes:

- **Prevent weakening of tube wall with improved expander**
- **Obtain satisfactory butt welds with removable spacers**
- **Stop catalyst jams in cracker with vapor disengager**

INCORPORATION of a valve mechanism in an orifice exchanger permits cleaning or replacing the orifice plate without stopping flow in the line to remove an entire flange or fitting. Instrument tubing likewise need not be disconnected.

The device is illustrated in several views in Fig. 1. Orifice plate D is in place concentric with the pipe line axis in Fig. 1A. It can be slid upwardly on grooves 6 in both main orifice casing A and exchanger body B. Valve C has been turned to a nearly vertical position (see also Fig. 1B). Rod 33, with a threaded end, has been inserted into cylindrical portion 32 of plate D. The plate is then simply lifted up into exchanger B by a pull on handle 36. Valve C can then be closed by turning it to a horizontal position; and casing B can be taken off by unscrewing bolts 4. Closed valve C prevents escape of any line fluid while casing B is off.

When plate D has been serviced or replaced and is ready to be returned to service: (1) exchanger B is bolted back in place on casing A; (2) valve C is reopened; (3) rod 33 is pushed down until plate D is again in proper position; (4) rod 33 is unscrewed from portion 32 and pulled up out of the way; (5) valve C is again closed (see Fig. 1C); and (6) exchanger body B is replaced with an ordinary flat cover plate B'. (See Fig. 1D).

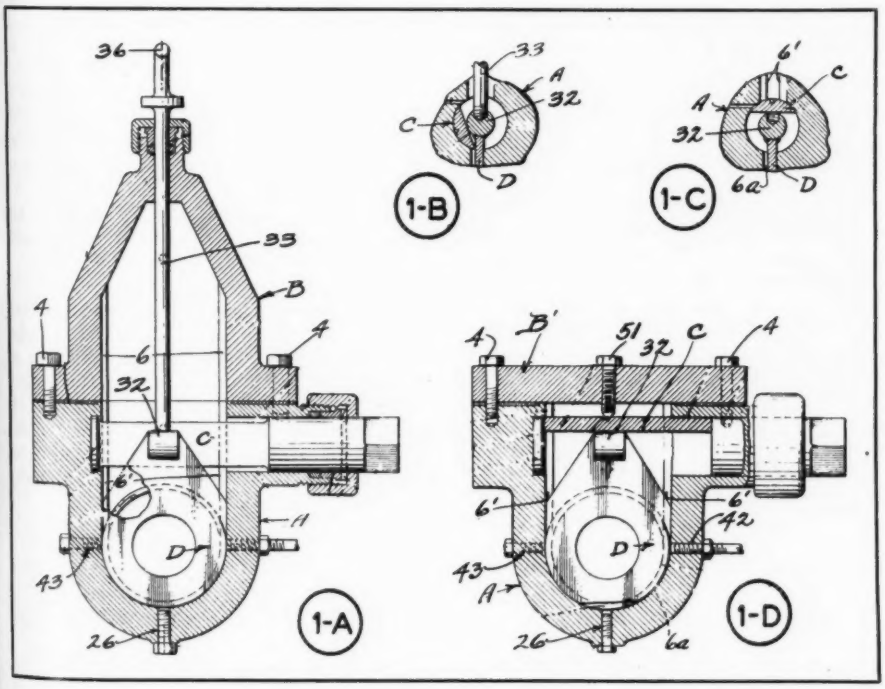


Fig. 1A—Exchanger B is in position for removal of plate D, with valve C in open position. Fig. 1B—End view of valve C in nearly vertical, or open, position. Fig. 1C—Valve C in closed position. Fig. 1D—Device in normal operating position, orifice plate D and cover plate B' in place (U. S. 2,448,071)

Taps 42 and 43 are for instrument tubing. Tap 26 is for flushing purposes. Bolt 51 insures a tight fit when plate D is in operating position.

U. S. 2,448,071, issued Aug. 31, 1948, to Bert E. Anderson, Los Angeles.

New Expander with Stop Collar Prevents Tube Walls Weakening

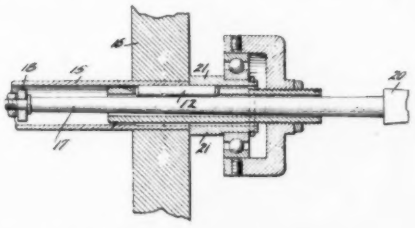


Fig. 2—Inside diameter of stop collar 21 limits the radial movement of roller 12 in improved tube expander (U. S. 2,448,512)

EXCESSIVE ROLLING with the resultant weakening of tube walls at the tube sheet is said to be prevented by use of an improved tube expander with a sensitive stop collar which also stops the cutting of chips and shavings.

The tool is shown in longitudinal cross section in a tube in Fig. 2. Conventional tapered mandrel 17 is driven by shank 20, rotating three tapered rollers 12 to expand the walls of tube 15 against tube sheet 16. The shaft is maintained concentric to the axis of tube 15 by means of guide roller 18.

In operation, the expander, with all parts revolving rapidly, is inserted until stop collar 21 meets the face of the tube sheet and the end of the tube and ceases to rotate. Mandrel 17 is then fed forwardly, forcing rollers 12 radially outwardly until their rear ends engage the inner surface of stop collar 21. This indicates by "feel" to the operator that the tube has been expanded the proper amount, because the inside diameter of collar 21 is the limit to which the tube is to be expanded.

U. S. 2,448,512, issued Sept. 7, 1948, to Newell Brackett, Bala Cynwyd, Pa.

Obtain Satisfactory Butt Welds By Use of Removable Spacers

CONVENTIONAL PRACTICE in butt-welding tubes and pipes is to use a so-called welding ring with flanges or studs to act as spacers and help in alignment. However, this frequently results in unwanted non-uniform welds and incompletely fused zones because of contamination of

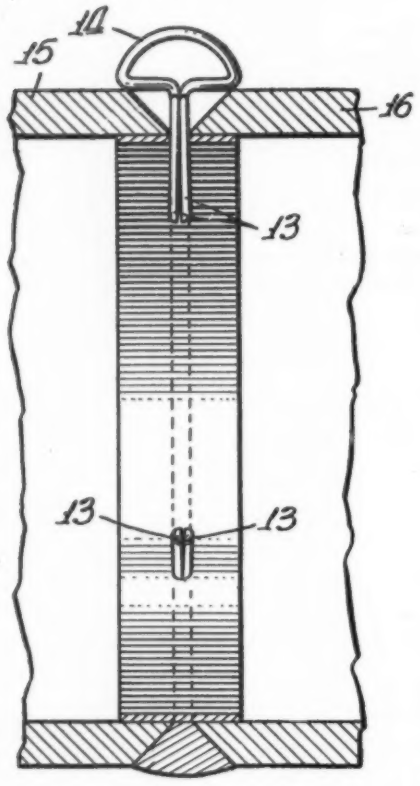


Fig. 3—Spacer pins 13 are removed from ring before final weld is applied, preventing an unsatisfactory joint (U. S. 2,448,107)

the finished weld by the spacers or flanges.

Use of the ring shown in Fig. 3 is said to solve this problem. The ring itself consists of a strip of sheet metal bent to cylindrical form. It is pierced at three or four points around its circumference to form holes 14 for the cotter-pin spacers 13. In use, the two pipe ends 15 and 16 are positioned with the ring and spacers in place as illustrated. A number of spot or tack welds are then made at locations between the several pins 13. The pins are then removed and the complete butt-weld applied.

U. S. 2,448,107, issued August 31, 1948, to John D. Mattimore and Fred C. Smith, assignors to Tube Turns, Inc., Louisville, Ky.

Stop Catalyst Jams in Cracker With Disengager for Seal Vapor

IN MOVING BED catalytic cracking units, occasional difficulties are encountered due to jamming and overloading of the throttle valve and the elevator by catalyst particles. This usually results from flow of seal vapor through the reactor drain pipe, transferring part of its kinetic energy to the granular material in the vicinity of, and below, the throttling valve.

A simple vapor disengaging device, or depressuring pot, one form of which is shown in Fig. 4, will serve to dissipate this energy and reduce the troublesome jamming, it is said. Essentially, it comprises a small vertical drum 13 installed in the drain pipe just above the throttling valve 18. Transverse baffle 19 in the drum forces disengaged seal vapors up to outlet 14.

In cases of limited space, the installation may require a very short distance between drum 13 and valve 18, in which instance an additional adjustable vapor seal baffle 17 will be needed to maintain valve 18 completely full of catalyst at all times, insuring accurate flow control.

U. S. 2,448,272, issued August 31, 1948, to John W. Payne, Charles V. Hornberg, and Robert D. Drew, assignors to Socony-Vacuum Oil Co., Inc.

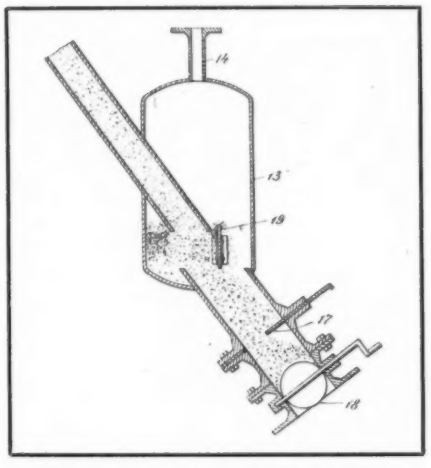


Fig. 4—Depressuring pot 13 stops jamming of catalyst particles in throttling valve 18 (U. S. 2,448,272)

Other Recent Patents

Space does not permit the complete review of all patents issued recently on equipment for the petroleum processing industry. Following, however, are brief abstracts of those with the greatest interest:

High Pressure Valve is constructed of two pieces of tubular steel to form a welded structure said to be able to withstand higher pressures than those which a conventional cast body will meet. U. S. 2,445,885, issued July 27, 1948, to Donald R. McMullen, Detroit, Mich.

Pressure Relief Valve uses combined spring and diaphragm mechanism to provide fast snap-action in reseating, and includes a rupture disk on discharge side for an additional seal. U. S. 2,448,429, issued Aug. 31, 1948, to Guy J. Henry, Chicago.

Self-aligning Pump Flange uses special packing and extra large I. D. to afford flexibility in assembling centrifugal pump and accompanying lines so as to reduce distortion and resultant frictional wear on driven portions of pump. U. S. 2,449,243, issued Sept. 14, 1948, to Paul Burt Miller, assignor to Pacific Pumps, Inc., Huntington Park, Calif.

Regulating Device for two-stage suction pump in which a bypass around the first stage is opened prior to the opening of a bleed valve into the second stage, and in which manual and automatic controllers are arranged in series so that each limits the control operations of the other. U. S. 2,449,217, issued Sept. 14, 1948, to Erwin W. Graham, assignor to Republic Flow Meters Co., Chicago.

Gate Valve Provides Tight Seal because seating members are carried on gate by flexible metal bellows: after gate is down, continued turning of valve wheel forces fluid under pressure into bellows and expands the seating members against the valve seats. U. S. 2,448,706, issued Sept. 7, 1948, to Samuel H. Edwards, Richmond, Calif.

Scraper for Double Pipe heat exchanger in wax separator, which is assembled in spring-mounted spider arrangement providing flexibility and enabling it to operate despite collection of ice or other irregularities in pipe wall, and the like. U. S. 2,449,012, issued Sept. 7, 1948, to Thomas E. Schley, assignor to Socony-Vacuum Oil Co., Inc., Beaumont, Texas.

Pulsation Absorber for reducing shock, "liquid hammer," and vibration; in which a length of ordinary rubber hose serving as a diaphragm is given needed strength by being placed in the annular space between two concentric, perforated tubes. U. S. 2,448,818 issued Aug. 31, 1948, to Joseph A. Pellettere, assignor to Gulf Oil Corp., Pittsburgh, Pa.

Liquid Level Control for boiler feed water regulation in which a freely moving non-metallic float carrying a magnetic element governs the control by its movement into and out of an exterior magnetic field. U. S. 2,448,251, issued Aug. 31, 1948, to Julian A. Campbell, Long Beach, Calif.

How to Obtain Patents

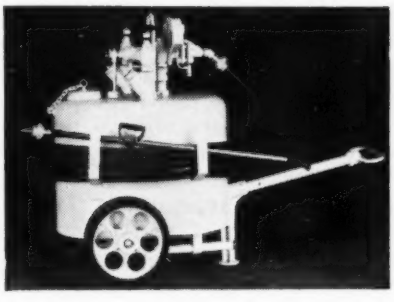
Readers may obtain copies of any U. S. patents from the Patent Office at 25 cents each. Order by patent number from: The Commissioner of Patents, Washington 25, D. C.

FOR MORE INFORMATION—use one of these reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the items you're interested in, fill in the rest of the card, and drop it in the mail. No postage needed

EQUIPMENT MATERIALS PROCESSES LITERATURE What's New!

Reviewed by WILLIAM C. UHL, Equipment Editor

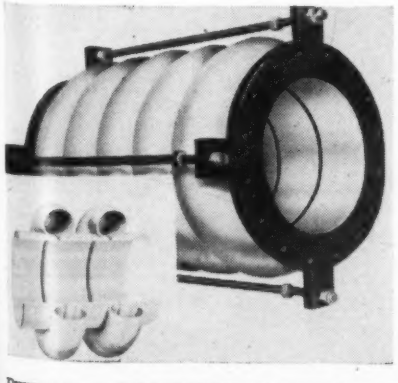
1—Exchanger Cleaner



Complete, safe cleaning of heat exchanger bundles, cooling coils and similar types of process equipment is claimed for the new portable "Hi-Pressure Jet Cleaner." It has a self-contained 50-gal. tank for a detergent, a 50-ft. pressure-type hose and nozzle, with operating controls for various cleaning jobs. Only connections to a steam and a water line are required. The temperature and the amount of detergent are adjustable; jet pressure is adjustable up to approximately double the initial steam pressure. Sellers Injector Corp.

2—Expansion Joint

Pipe movement, axial, transverse, lateral, or vibratory, is said to be taken up uniformly by each self-equalizing corrugation of the new Omega Expansion Joint. Stresses and fatigue rate are negligible in comparison to conventional designs, and thinner metal can be used for a given pressure. Omega Joints are made with an I.D. from 1/2 in. to 25 ft., and for any pressure from vacuum to 50,000 psi. Temperatures from sub-zero to over 2000° F. can be accommodated. Cross sections may be round, rectangular, or special, and ends are for flanged, welded, or screwed joints. All ferrous and non-ferrous metals can be used. Marquette Coppersmithing Co.

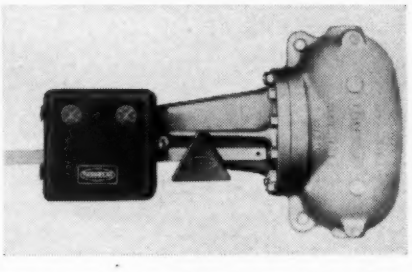


3—Twin Hose Reduces Tangles

Tangled, twisted welding hose resulting from individual oxygen and acetylene lines are an accident-inviting, tripping hazard that can be eliminated by the new "Twin-Weld" hose which puts both lines in one unit. This hose is a single line, made up of two lines of cord-reinforced hose molded side by side. Hewitt Rubber Division, Hewitt-Robins, Inc.

4—Level Controller

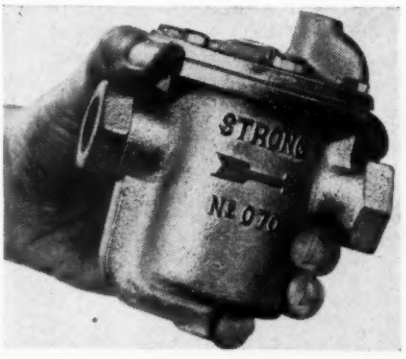
The new Model 92-0600 External Chamber Instrument Type Ball Float Level Controller represents a combination of the long range variable displacement type with the ball float



type level controllers, said to have the advantages of both. The proportional band is adjusted easily from 2 to 100% on a graduated scale. The control mechanism does not load the ball float measuring system, and the response is limited only by that of the ball float assembly. It is available in external chamber, internal flange, and internal shaft controllers. Mason-Neilan Regulator Co.

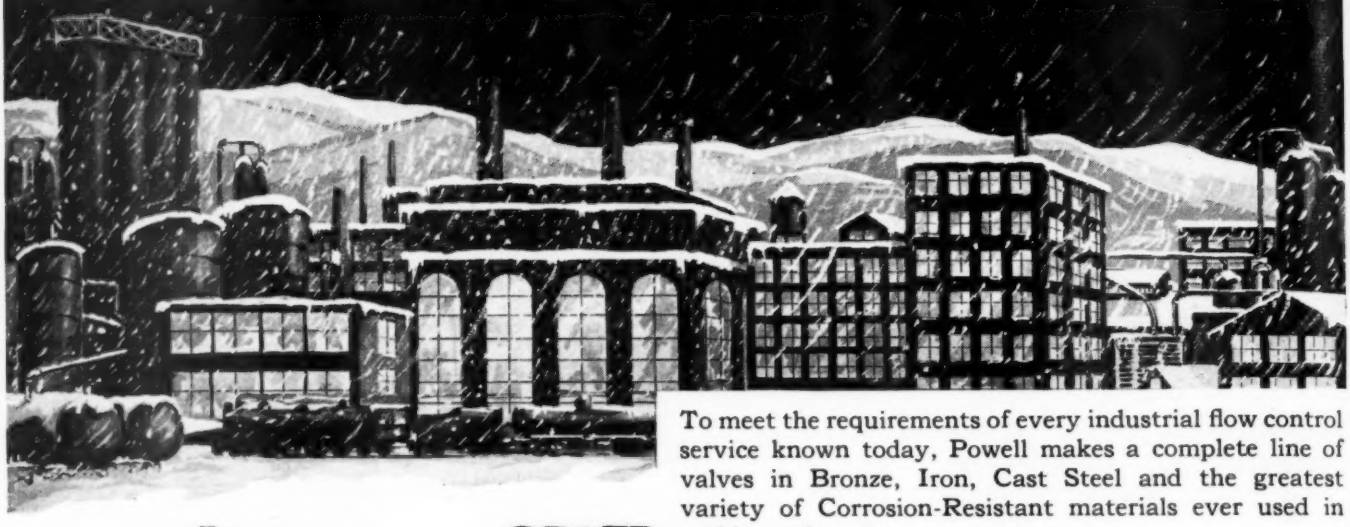
5—Small Drainage Trap

Designed particularly for standard applications wherever small drainage is a problem, the No. 070 Steam Trap is available for pressures from 0 to 150 psi. where condensate loads are light and conditions call for the economy of an inverted bucket trap. Special features include: renewable seat, seamless deep drawn, stainless 18-S bucket, oversized ports, wear-resistant "Anum-Metl" valve and seat, and "Hi-Cap" orifice. Strong, Carlisle & Hammond Co.



More "What's New!" Items, p. 1107

POWELL VALVES cover all Industry



To meet the requirements of every industrial flow control service known today, Powell makes a complete line of valves in Bronze, Iron, Cast Steel and the greatest variety of Corrosion-Resistant materials ever used in making valves.

We cannot introduce "Powell Valves for Corrosion Resistance" as a *new* feature, because with us they are long past the introductory stage. In fact it was more than 25 years ago that the Powell Special Design and Alloy Valve Division was established.

But we *can* feature the fact that today Powell makes the only *complete line* of Corrosion-Resistant Valves available to the Chemical and Process Industries.

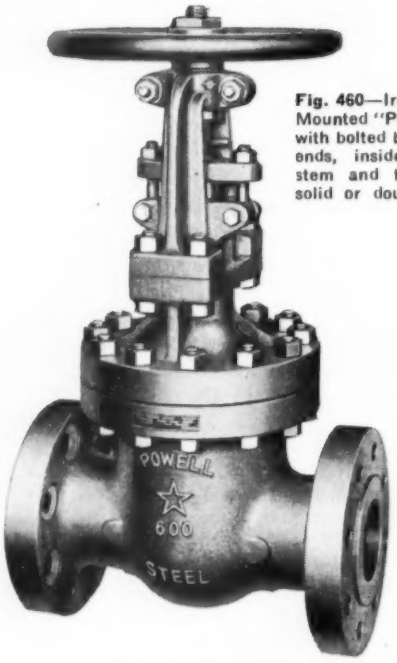


Fig. 460—Iron Body Bronze Mounted "Pilot" Gate Valve with bolted bonnet, screwed ends, inside screw rising stem and tapered wedge, solid or double. ➔

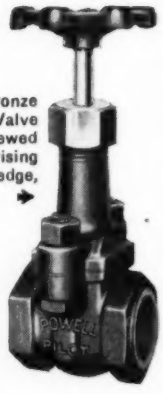


Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

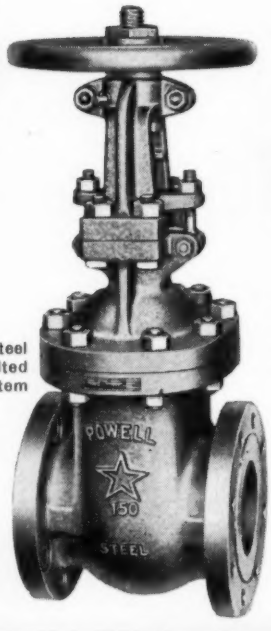


Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge.

For full information on applications of Powell Corrosion-Resistant Valves, refer to Powell Catalog No. 242. If you do not have it, write, on company stationery, for your copy NOW!

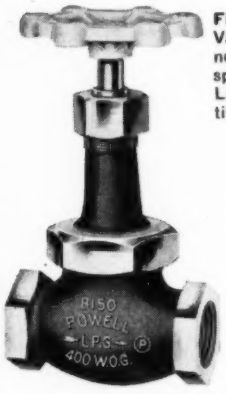


Fig. 8150—Bronze L. P. G. Globe Valve with screwed ends, union bonnet and special composition disc. Inspected and listed by Underwriters' Laboratories', Inc. Write for descriptive circular—8-48B.

Fig. 1444—125-pound Iron Body Bronze Mounted Gate Valve with outside screw rising stem, bolted flanged yoke and tapered wedge. ➔

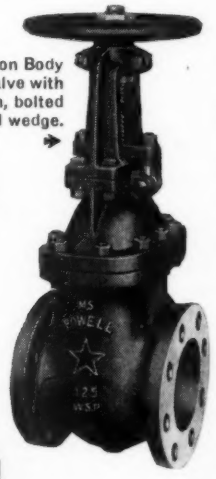


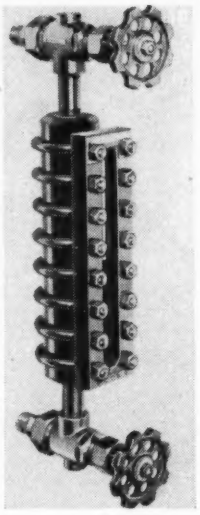
Fig. 190—150-pound Iron Body Bronze Mounted "Irenew" Globe Valve. Has screwed ends, union bonnet and regrindable, renewable wear-resisting "Powellium" nickel-bronze seat and disc. ➔

The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

POWELL VALVES

6—Light Ends Gage



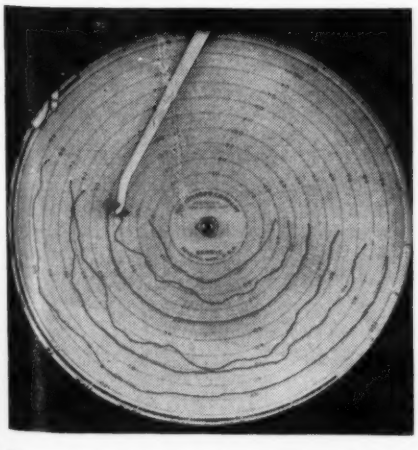
Designed for use on light ends services, the new Large Chamber Gage is said to give high accuracy in liquid level reading of liquids that boil and fluctuate rapidly in the glass. The large chamber holds disturbances of the meniscus to a minimum, a feature not obtained in the conventional gage with narrow chamber. The Gage is of the flat glass, reflex type, and is made in sections up to any desired length, in multiples of the standard Jerguson No. 7 Reflex Glasses. Jerguson Gage & Valve Co.

7—Clean, Dry Floors

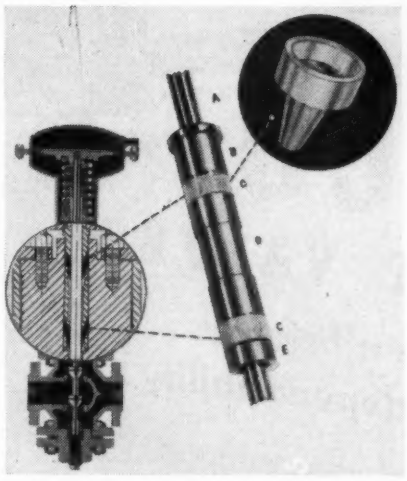
Reduced maintenance costs, improved working conditions, and safety are said to be the chief advantages of Industrial "Floor-Dry," a drying agent for floors with high absorptive properties for oil, grease, and water drippings. A granular material, it does not become slippery or soggy when saturated. Eagle-Picher Co.

8—Multiple Recorder

The new "Multi-Record" Recorder will make from one to six different records on one circular chart, the records being of colored dots so closely spaced as to make virtually continuous lines. The instrument has only one measuring system, either resistance bulb or EMF type; but a positive-acting switching unit automatically brings the vari-colored pens into recording position at 6-second intervals, in any sequence desired. Complete color-coding prevents possible mis-mating of circuits and pens. The six pens are held in a "Rotacolor Pen Wheel" and are magnetically selected in turn and held in recording position by the single pen arm. The instrument can be used for temperature, pressure, humidity, liquid level, pH, conductivity speed, or other process variables. The ink is of the dry type and needs refilling only once every several weeks. Foxboro Co.



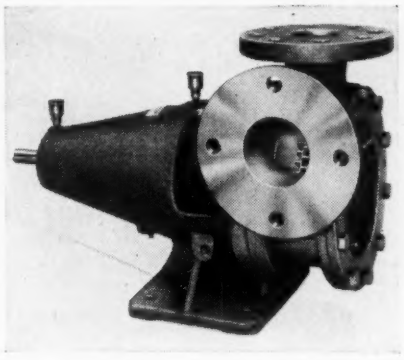
9—Packingless Valve



Eliminating the need for a packing box in a control valve, the new "Dahl-Seal" will provide a frictionless, leakproof, valve stem, regardless of the static pressure on the valve body. An inert plastic, its special shape will seal the stem hermetically by the force of the system pressure. No take-up or adjustment is necessary because of its inherent lubrication properties and chemical resistance. The valve stem can be positioned to an accuracy of 0.001 in. at full vacuum, atmospheric, to 25,000 psig. Component parts as shown in the illustration are: (A) super-finished plug stem, (B) gland follower, (C) Dahl-Seal, (D) gland, (E) lower gland. In field tests at pressures up to 8500 psi., no failures have been reported in over two years' continuous service. Hammel-Dahl Co.

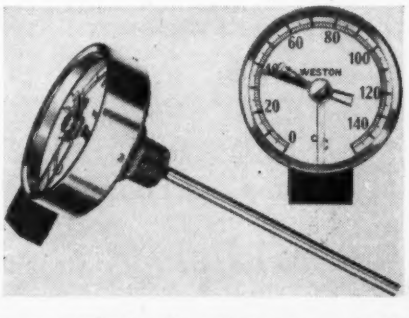
10—Turbine Type Pump

The Series 300 Roth Turbine Type Pump is being manufactured specifically for the petroleum industry, according to the maker. It develops pressures up to 175 psi. in single stage, at operating speeds of 1750 rpm., and delivers capacities to 150 gpm. It is said to be inherently self-priming and handles a certain amount of air and vapors without losing its prime or vapor binding. The pump has flanged inlet and outlet and is fitted with an extra deep stuffing box, a single multivaned impeller, and an oversize stainless steel shaft in double ball bearing construction. Roy E. Roth Co.



11—Alarm Thermometer

A simplified temperature alarm or control device is offered in a new contact-making thermometer recently introduced. The instrument consists of an all metal thermometer with an adjustable contact arm mounted in the glass and bezel as illustrated. A screw-type terminal block mounted on the periphery of the case front provides for an easy electrical connection. Contacts are of the magnetic type to assure positive make and break action. The arm can be set over the entire scale, and contact can be broken manually after an alarm has been sounded; however, the contact breaks automatically on a temperature change of about 5%. The thermometer can be supplied to make contact on either rising or lowering temperature. Accuracy as an indicator is ±1%, and as a controller ±1½% of full scale range. Standard stem lengths available from 2-1/2 to 24 in., longer stems on special order. Weston Co.



More "What's New!" Items, p. 1109

View of Oceco 3" Screwed Connection Vent Valve with Flame Snuffer and Chain.

OCECO
V-113 VENT VALVES
for maximum efficiency, economy and dependability

View of Oceco 6" Flanged Connection Vent Valve showing mounting on Oceco Flame Arrestor.

● Oceco Vent Valves provide positive and dependable control of tank breathing. They prevent the free discharge of vaporized liquids resulting from fluctuations in temperature,—and restrict tank breathing, resulting from pumping into a tank. They avoid any serious lowering of gravity ratings;—retard the formation of gum;—and avoid "cave-ins" and "blow-outs" resulting from excessive vacuum and pressure.

These valves combine the advantage of our twenty five years of experience in meeting the industry's most exacting requirements;—and the results of exhaustive tests conducted in our laboratories. The Venturi effect of the body gives the valves even greater pressure capacity than an open nipple, while the spacing and design of the openings provides large vacuum relief. The drip edges on the valves carry away any condensate, thus protecting the valves against corrosion and freezing, and the stem guided construction prevents sticking and "cocking."

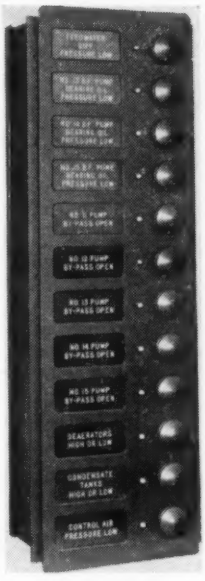
The housings are semi-steel castings that can withstand direct exposure to flames for long periods of time, and consequently provide a solid support for the valves, valve guides and seats, keeping them in proper alignment and assuring tight closure at all times.

Furnished in 2" and 3" sizes for screw mounting, and 4", 6", 8", 10" and 12" sizes for flange mounting, either as individual units or complete with an Oceco Flame Arrestor. Prices and a fully descriptive bulletin sent promptly on request.

OCECO
Division of THE JOHNSTON & JENNINGS CO.
CLEVELAND 14, OHIO

NEW YORK • PITTSBURGH • DETROIT • CHICAGO • ST. LOUIS • TULSA • BEAUMONT
MOBILE • CASPER • SAN FRANCISCO • LOS ANGELES • TORONTO AND MONTREAL

12—Narrow Annunciator

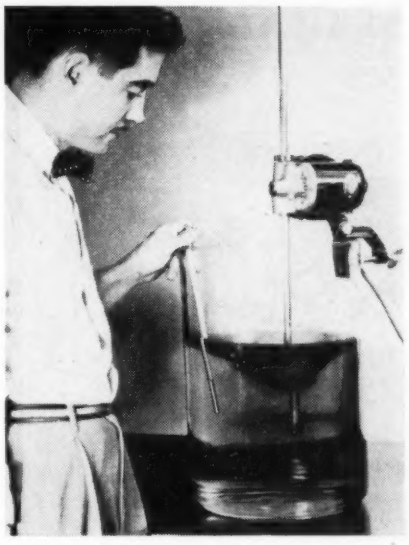


The new "ANF-(S)" Model Annunciator is one-half the width of its so-called "double-style" predecessors, measuring 10 in. wide, and facilitating installation in new or existing panel boards and control racks. Size of the designation windows remains the same, 2 x 4-1/2 in., and the annunciator may be made up of as many windows as required. It will operate on any of the standard voltages, and may be furnished for either AC or DC operation. An optional feature of the ANF(S) is a second audible alarm which indicates return to normal operation, and which can be silenced by pressing the reset switch. Each individual unit is jack-connected for easy withdrawal from the rear of the cabinet without disturbing permanent wiring circuits and connections. The Autocall Co.

13—Tube Expanders

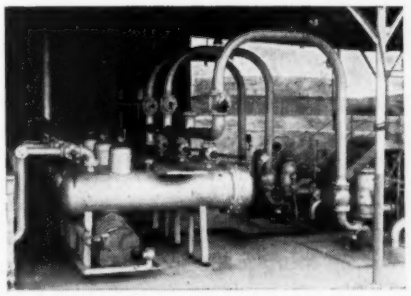
A feature of two new self-feeding tube expanders is an adjustable ball bearing thrust collar and mechanism which is said to eliminate cage friction and result in smoother rolling operations and longer expander life. During operation, the adjustable thrust collar remains stationary against the tube end, and the thrust load is transmitted to the ball bearings, minimizing frictional heating and the cutting of tube ends. The two models are the G-800 and G-1200, and are for rolling of condenser and heat exchanger tubes of 1/2 in. O. D. to 1-1/2 in. O. D. They are reported to be especially effective in rolling bi-metal tubes and for use in thick tube sheets. The G-800 is made with two roll lengths, for tube sheets from 1/2 to 2-1/4 in. thick; the G-1200 also is made with two roll lengths for sheets 1-1/2 to 6-3/4 in. thick. Aire-tool Mfg. Co.

14—Heavy-duty Stirrer



Recommended for thick, viscous materials, the Eastern Model No. 8 Stirrer is said to be suitable for agitating from 1 to 10 gals. of heavy fluid, and will handle larger quantities of thin mixtures. Powered by a G. E. universal open frame motor rated at 1/15 hp. for continuous duty, AC or DC, 110 volts only, the motor is geared for a maximum countershaft speed of 840 rpm. Rheostat control permits variable speeds of 80 to 840 rpm. The 1/2 in. propeller shaft can be adjusted to length within a 30 in. range by means of a hollow gear shaft and a collet chuck at the top of the gear case. A two-blade, stamped stainless steel propeller, 5-1/2 in. in diameter is held in place by a stainless steel cap nut. The stirrer is available with a screw clamp or ringstand handle mounting. Eastern Industries, Inc.

More "What's New!" Items, p. 1110



EXCEL-SO

SEPARATORS

Solve the Problem

3-HP-300 (300 gpm) 150 # w. p. SOD EXCEL - SO Separators filtering pipe scale and removing water from products pipe line. Note air eliminator domes and mechanisms now built into separators where required. This installation made for:

MASSACHUSETTS PIPE LINE CO.

Everett, Mass.

USE THIS COUPON

WARNER LEWIS COMPANY

BOX 3096P - TULSA, OKLAHOMA

Please send additional information on Excel-So Separators

EXCEL-SO

Name _____

Street _____

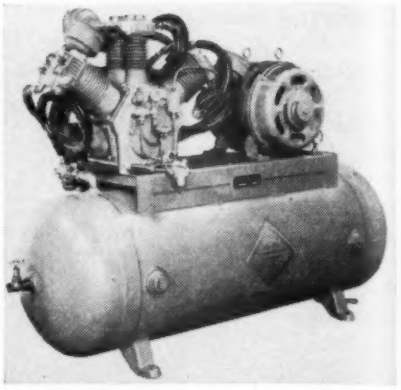
City _____

15—Piping Slide Rule

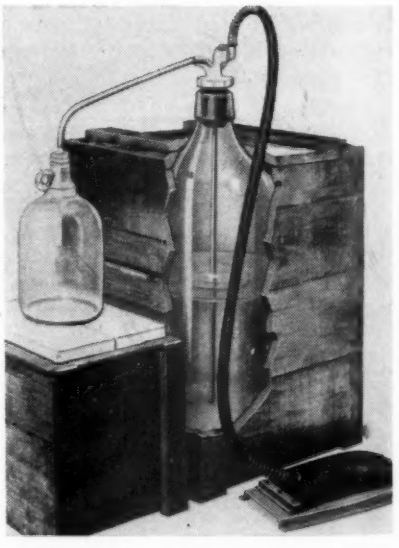
The Tube-Turn Velocity and Pressure Drop Calculator provides in slide rule form a tool for engineers working on fluid flow problems. It will give two kinds of answers according to the manufacturer: (1) a quick estimate based upon the pipe friction factor of 0.006, and (2) an accurate solution, derived from the estimate by applying a correction factor to the straight pipe losses. One part of the rule is devoted to liquids and another to gaseous fluids. Due to compressibility effects, the calculator will not give accurate solutions for gaseous fluids where the pressure drop exceeds 10 to 15% of the initial pressure. Tube-Turns, Inc.

16—Air Compressor

With the new "Air-Flo" basic air compressor, 18 principal parts can be used to construct as many as 48 different models of 1, 2, 3, 4, or 6 cylinder pumps in single or two-stage types. Complete interchangeability permits carrying a small inventory of replacement parts readily available for any compressor. Compressors are available for prompt shipment, manufacturer states, in sizes from 1/2 to 40 hp. with 2.5 to 275 cfm. capacity at 30 to 300 psi. pressure in vertical, V type, or side angle construction, with single, twin, or radial staggered cylinder arrangements. Air-Flo Compressor Co.



17—Safe Acid Pump

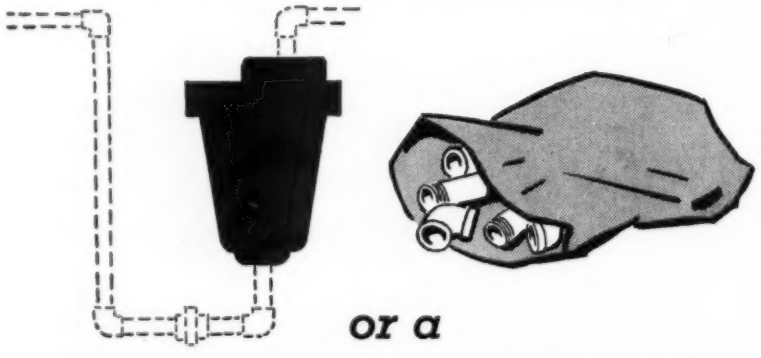


The "G-S" Pneumatic Acid Pump provides either foot or hand operation for safe and convenient transfer of acids or other liquids from carboys or drums. Liquids come in contact only with the corrosion-resistant tube. Pumps with lead tubes are suitable for sulfuric, hydrochloric, and hydrofluoric acids; Saran plastic tubes are recommended for nitric, muriatic, citric, phosphoric, acetic acids, and bleaches. General Scientific Equipment Co.

More "What's New!" Items, p. 1112

?

A Conventional Steam Trap and a BAG of fittings



or a

SUPER-SILVERTOP

The savings you realize by using Super-Silvertop Steam Traps are more and more important in today's market as costs keep climbing. The water seal or U-tube built into each Super-Silvertop saves you as many as eight fittings—it also saves up to an hour of installation time per trap. And you pay no premium for this simplified piping economy, there is no extra charge for this superior trap engineering.

Over 58 years of steam trap manufacturing back up this Super-Silvertop design—a design that for years has proved that Super-Silvertop is a "long-life", trouble-free trap. Let us send you full details, contained in the book, "How To Choose A Steam Trap", a free, helpful reference work regardless of what trap you use.

THE V. D. ANDERSON COMPANY
1974 WEST 96TH STREET • CLEVELAND 2, OHIO

It's CRANE for complete selection

...on any refinery piping job

ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

Take this vapor recovery process piping, for example. Every item for the system is in the Crane line. **One catalog** places at your finger tips the world's greatest selection of valves, fittings, accessories and pipe. **One order** to your local Crane Branch or Wholesaler covers all your needs—in brass, iron, steel and corrosion-resistant alloy materials.

To standardize on Crane as your **One Source of Supply** is to simplify all piping procedures, from design to erection to maintenance. **Complete Responsibility** on Crane for all piping delivered to the job helps you to get the best installations, avoid needless delays. And the traditionally **High Quality** of every item from Crane means continued, dependable service from process piping systems.

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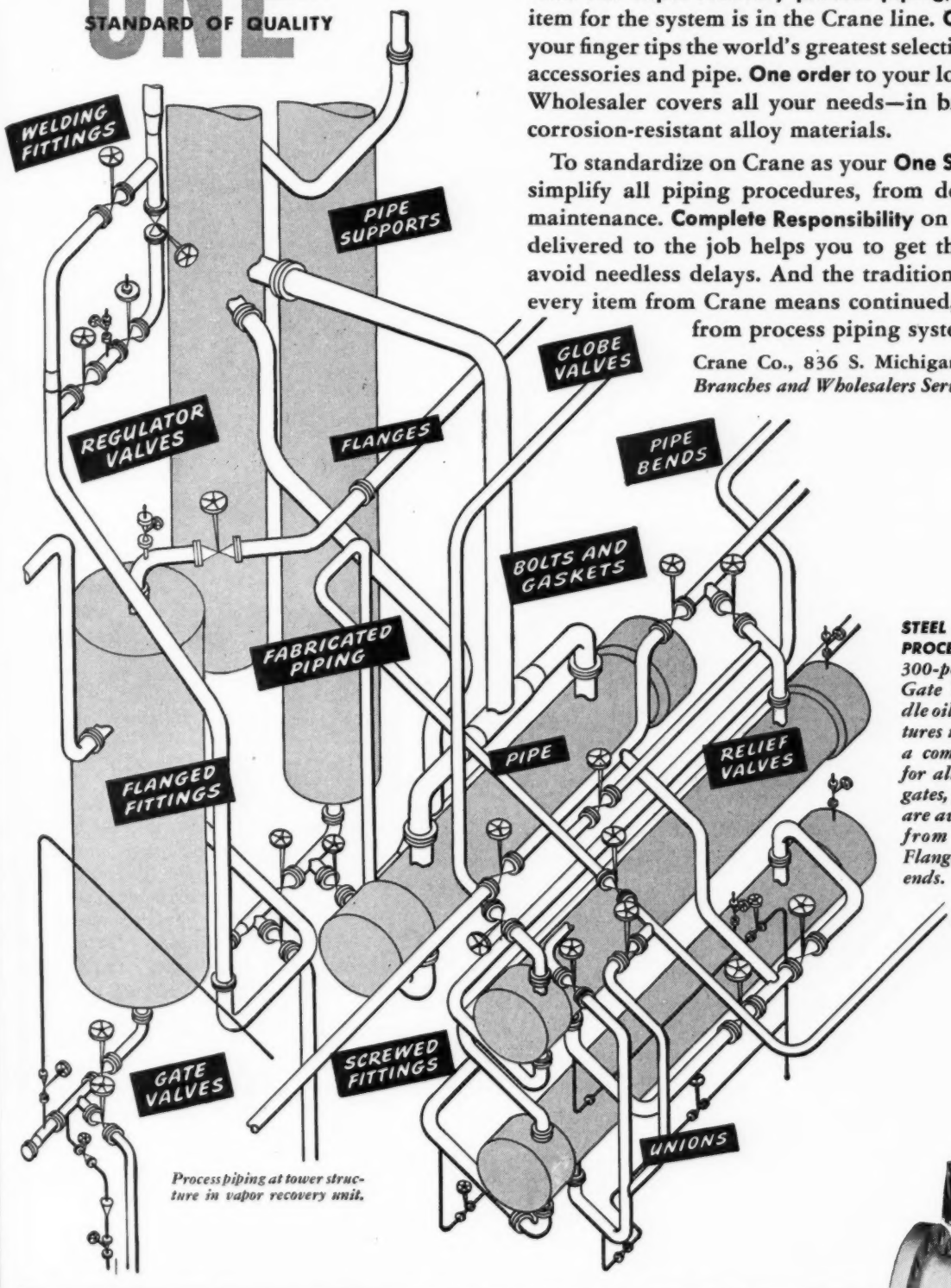
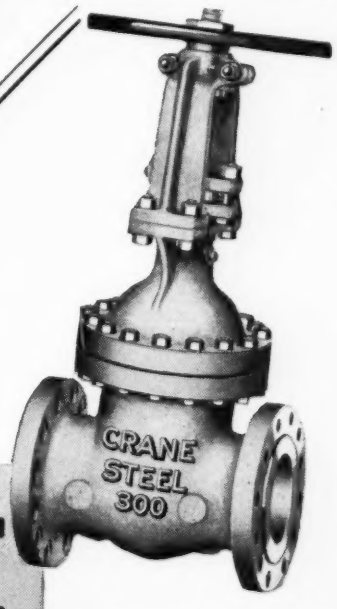


Process piping at tower structure in vapor recovery unit.

STEEL VALVES FOR PETROLEUM PROCESSORS—*Crane No. 33X 300-pound Cast Steel Wedge Gate Valve. Trimmed to handle oil and oil vapor at temperatures up to 1000 deg. F. One of a complete line of steel valves for all refinery services. Crane gates, globes, angles, and checks are available in pressure classes from 150 to 2500 pounds. Flanged, screwed, or welding ends. See your Crane Catalog.*



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VALVES • FITTINGS
PIPE • PLUMBING
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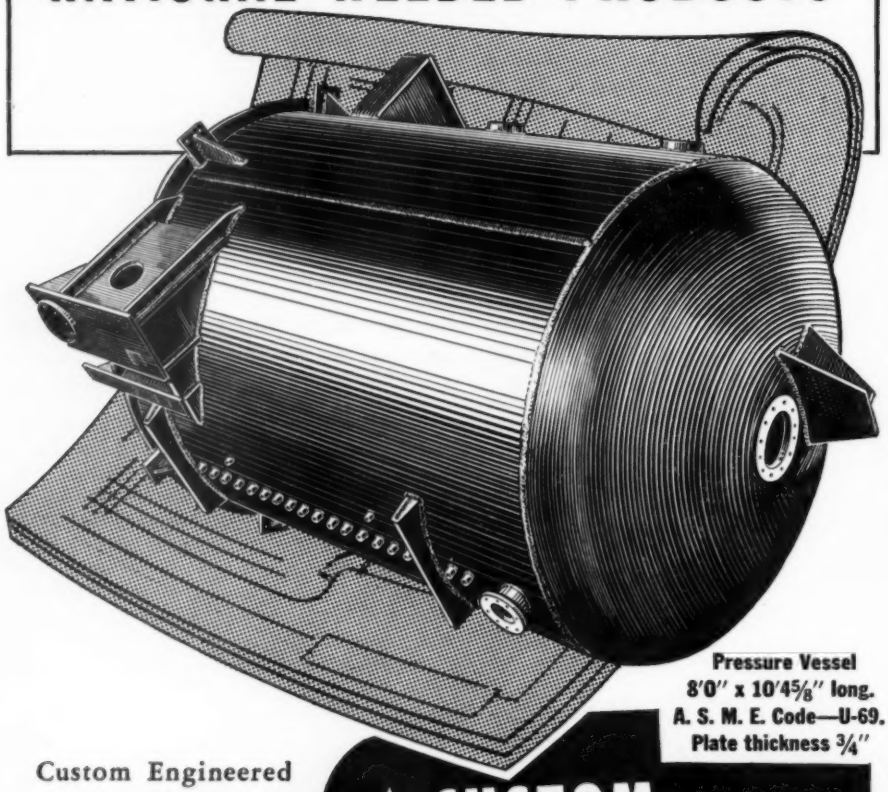
CRANE

FOR EVERY PIPING SYSTEM

NATIONAL WELDED PRODUCTS



Pressure Vessel
8'0" x 10'4⅝" long.
A. S. M. E. Code—U-69.
Plate thickness ¾"

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TO MEET EXACTING CODES AND REQUIREMENTS
FROM OPEN HEARTH, STAINLESS, STAINLESS CLAD, NICKEL, NICKEL CLAD, ALUMINUM

Custom Engineered by NATIONAL means reliable and durable equipment for the chemical, processing and petroleum industries. All manufacturing operations such as forming, welding, stress relieving and machining are performed within our own plant—under the constant protection of X-ray and manual inspections.

NATIONAL will gladly work with you while your plans are in the formative stages, or from completed blue prints. Write for Bulletin which shows our complete fabricating facilities.

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ANNEALING BOX COMPANY
API-ASME Codes · Stress Relieving · X-ray
Pledged to Quality Since 1895
WASHINGTON, PENNA.

What's New!

18—Refinery Fire Truck

Said to be the first truck designed to use dry chemical as the primary fire extinguishing agent, the new Ansul Fire Truck is adaptable for fighting fires in oil refineries, chemical plants, and the like, according to the manufacturer. A total of 2800 lbs. of dry chemical and 250 gals. of water are carried on the truck. Fully loaded, the vehicle weighs 21,500 lbs. It is 95-3/4 in. wide and 21 ft. 6 in. long. Cab height is 8 ft., turret height

is 10 ft. 6 in. Truck has four-wheel drive, five speeds forward and one reverse. Maximum governed speed is 62 mph., but governor can be removed where greater speed is desired. Extra compartments on the sides house accessory fire and rescue equipment. Ansul Chemical Co.

19—Safety Valve Shut-Off

A new safety fuse shut-off is optional equipment on "Oilco" horizontal or angle-type loading line valves. Shut-off, which reacts the moment either fire or a 204° F. temperature reaches the valve, employs small stop-lug to catch a plunger discharged from the device when released by a safety fuse. Valves operate under pressures up to 125 psi., and are supplied in sizes 2, 2-1/2, 3, and 4 in. The valve may be operated manually after closing through safety fuse action. Oil Equipment Mfg. Co.

20—Laboratory Flowmeters

Two models of the new "Flometer," a glass rotameter, are said to cover almost the complete range of laboratory requirements. Model G9146, 8 mm. O.D. x 9-1/2 in. long, is for small flows. It covers 30-900 cc./min., using a steel and glass ball float in the same tube. Model G9147, 12 mm. O. D. x 9-1/2 in. long, covers the range 1000 to 38,000 cc./min. Emil Greiner Co.

More "What's New!" Items, p. 1113

Complete Selection

OF YOUR FITTINGS NEEDS FROM THE LADISH *Controlled Quality* LINE

TO MARK PROGRESS

SEAMLESS WELDING FITTINGS
½"-30" STD. thru XXH

- 90° Elbows
- 45° Elbows
- 180° Return Bends
- Full Branch Tees
- Reducing Outlet Tees
- Concentric Reducers
- Eccentric Reducers
- Lap Joint Stub Ends
- Saddles & Caps

SEAMLESS REDUCING ELBOWS
2"x1"—6"x5" STD. & XH

FORGED STEEL FLANGES
½"-30" 150# thru 2500#

- Welding Neck
- Slip-on
- Lap Joint
- Threaded
- Blind
- Socket-Welding
- Reducing
- Orifice Unions

LONG WELDING NECKS

FORGED STEEL FITTINGS
Screwed & Socket Weld
⅛"-4" 2000# thru 6000#

- 90° Elbows
- 45° Elbows
- Tees
- Crosses
- Street Elbows
- Laterals
- Couplings
- Reducers
- Bushings
- Plugs
- Caps

AVAILABLE IN CARBON, ALLOY AND STAINLESS STEELS

You can secure your entire requirements from one source by standardizing on the complete Ladish line of Seamless Welding Fittings—Forged Steel Flanges —Forged Steel Screwed and Socket Welding Fittings. Complete range of sizes . . . Carbon, Alloy and Stainless steels . . . forged to the uncompromising standards of Ladish Controlled Quality.

A COMPLETE LINE PRODUCED UNDER ONE ROOF . . . ONE RESPONSIBILITY

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Improve Gasoline Storage Stability with Du Pont Gasoline Antioxidants

A technician in one of the district laboratories preparing to make an antioxidant evaluation. These helpful services are available to the Petroleum Industry.

All gasolines do not have the same likes and dislikes when it comes to antioxidants. That is why Du Pont offers you *three* gasoline antioxidants—from which you can choose the one best suited to your gasoline. All provide efficient, economical control of oxidation to give the improved storage stability you want.

Du Pont Gasoline Antioxidant No. 22 may be added immediately after final fractionation and before doctor sweetening or caustic washing. This means less possibility of early gum formation. It is also one hundred per cent active ingredient, containing no solvent.

Du Pont Gasoline Antioxidants Nos. 5 and 6 are of particular interest to many refiners where control of copper dish gum is of major importance.

Send for samples to find the one best suited to your gasoline—or obtain them from your Du Pont Petroleum Chemicals representative.

The Du Pont District Laboratory in your area will be glad to assist you in evaluating these antioxidants, as well as other Du Pont additives.

Technical Bulletins are available on Du Pont Gasoline Antioxidants Nos. 5, 6, and 22. Write the nearest District Office for your copies.

- *Tetraethyl Lead Compounds*
- *Gasoline Oxidation Inhibitors*
- *Gasoline Dyes*
- *Lubricating Oil Additives*
- *Fuel Oil Additives*

No. 5 Antioxidant No. 5 is a solution containing 50% Normal-butyl-paraminophenol, 30% Anhydrous iso-propanol, and 20% Anhydrous methanol.

PROPERTIES

Specific Gravity at 60°/60°F 0.91
Pounds per Gallon at 60°F 7.57
Flash Point (Tag C.C.) °F 60
Viscosity at 100° F., S.U.S. 41
Solidification Temperature, °F .....—20

No. 6 Antioxidant No. 6 is a solution containing 50% Isobutyl - para - aminophenol, 30% Anhydrous iso-propanol, and 20% Anhydous methanol.

PROPERTIES

Specific Gravity at 60°/60°F 0.91
Pounds per Gallon at 60°F 7.57
Flash Point (Tag C.C.) °F 60
Viscosity at 100° F., S.U.S. 41
Solidification Temperature, °F 0

No. 22 Antioxidant No. 22 is a commercial grade of N:N'-disecondary butyl-para-phenylenediamine containing no solvents.

PROPERTIES

Specific Gravity at 60°/60°F 0.94
Pounds per Gallon at 60°F 7.67
Flash Point (C.O.C.) °F 290
Viscosity at 100° F., S.U.S. 64
Solubility in Water at 80°F., Weight % .....< 0.05
Solubility in Gasoline at 80°F ....In all proportions

E. I. DU PONT DE NEMOURS & CO., (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware
District Offices: Wilmington, Del.; Chicago, Ill.; Tulsa, Okla.; Houston, Texas; Los Angeles, Cal.

PETROLEUM CHEMICALS

DU PONT
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BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

Trade Literature

21—Rotary Gear Pumps

Kinney Rotary Liquid Pumps, Bulletin L48, a 46-page booklet covering a line of gear pumps especially applicable to handling heavy, viscous liquids, such as asphalts and the like; includes four pages of helpful engineering tables. Kinney Mfg. Co.

22—Analytical Instruments

Analytical Instruments for Science & Industry, Catalog CEC-1300A, covers in brief form a complete line of mass spectrometers, recording oscillographs, leak detectors, electrical computers, and the like. Consolidated Engineering Corp.

23—Air-driven Pump

Airometric Pump, Bulletin No. 488, describes a controlled volume chemical pump with rotary air or gas motor drive, including flow diagram for installation on automatic pH control, and a capacity-pressure selection table. Milton Roy Co.

24—Metallizing Equipment

The Best of Everything for Metallizing, Catalog 401; presents a complete line of guns, spray booths, controls, accessories, and supplies for use in applying metal spray coatings for repairs. Metallizing Engineering Co., Inc.

25—Stroboscopic Flowmeter

Stroboflow, an Ocilloscope for Hydraulics; a four-page bulletin giving details and operating principles of a new type flowmeter utilizing a stroboscope for measuring rotational speed of a rotor revolved by the flowing fluid, and with a reported accuracy of 0.01 to 0.02%. Flowmeter Corp. of America.

26—Smoke Recorder

Bailey Smoke Density Recorder, Bulletin 211, describes a new electronic instrument useful for checking furnace combustion conditions and also for reducing the quantity of smoke being emitted from the stack; for example, in areas covered by rigid civic ordinances. Bailey Meter Co.

27—Waste Instrumentation

Instrumentation for Treatment of Sewage and Industrial Wastes, Catalog No. 7301; a 43-page booklet discussing the applications for measuring and controlling instruments for sewage and waste processes, and including boiler plant instrumentation. Brown Instrument Co.

28—Oxygen Process

Powerfax, Autumn, 1948; includes an article describing the new Elliott process for manufacture of oxygen, an atmospheric air distillation system, combined with a nitrogen liquefaction and refrigeration system, all under automatic control. Elliott Co.

29—Welding Guide

Designers' Guide for Welded Construction gives standard arc welding symbols, properties of base metals and weld metals, and other design data in such form that it can be placed under a desk glass or tacked to a drawing board for quick reference. Lincoln Electric Co.

30—Nickel Specialties

Standard Specialties, a 24-page compilation of products made from Monel, Nickel, or Inconel, and available from stock or standard designs from various makers; including sizes and specifications under 47 general classifications such as tubing, piping, fittings, wire rope, thermostat parts, floats, etc. International Nickel Co., Inc.

31—Instrument Catalog

Wheelco Electronic Controls, Bulletin Z6500, a condensed catalog and price list, gives up-to-date information on a line of indicators, controllers, recorders and combustion safeguards. Wheelco Instruments Co.

32—Vacuum Valves

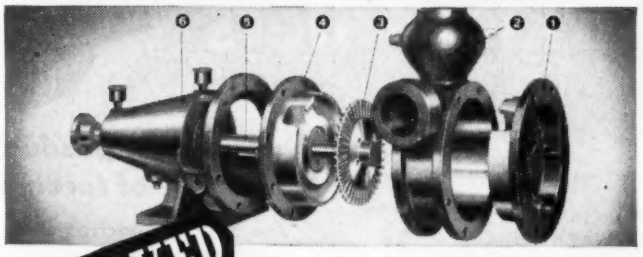
Kinney Vacuum-Tight Valves, Bulletin 2448, presents specifications, dimensions, and shipping weights of cast steel and bronze globe valves for the operation of systems at low absolute pressures by use of special bellows in place of usual stuffing box at valve stem. Kinney Mfg. Co.

33—Welding Fittings

Bonney WeldOlets for Branch Pipe Outlets, No. W-2, a 20 page catalog and engineering reference book tells how these fittings reduce piping costs from 50 to 75%; giving installation instructions, specifications, and list prices on three types, for butt and socket welding, and threaded. Bonney Forge & Tool Works.

More "What's New!" Items, p. 1114

PUMPING PROBLEMS*



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Look at these features:

1. Outboard head—easily removed.
2. Case—can be rotated to various positions.
3. Impeller—self adjusting, no seizing at high temperatures.
4. Inboard head — only one packing box.
5. Stainless steel shaft.
6. Heavy cast iron frame.

Stainless steel heads, impeller, and case available.

- Flexible coupled and close coupled pumps in stock.
- Motors up to 25 HP in stock.

Write for catalogs 1 & 2.

*Whatever your pumping problem, consult Roth. Experienced engineers will recommend the equipment you need—will design special pumps for unusual applications.

Speeds up to 3600 RPM
Capacities up to 200 GPM
Pressures up to 175 lbs.
Viscosities up to 500 SSU

ROY E. ROTH COMPANY • 2426 Fourth Avenue • Rock Island, Illinois

ROTH PUMPS

34—Fluid Cracking

The Kelloggram, Issue 5, 1948 comprises a historical review of progress made in fluid cat-cracking since 1942 when the first such unit went on stream at Esso Standard Oil's Baton Rouge refinery. M. W. Kellogg Co.

35—Pneumatic Control

L&N Pneumatic Control, Catalog ND4B, 24-page booklet showing by photos, diagrams and test curves the design features of a complete, air-actuated control system for oil or chemical processes said to provide faster start-ups, longer onstream runs, fewer process drifts. Leeds & Northrup Co.

36—Precision Instrumentation

Atcotran, the New Precision Instrumentation System, Bulletin R-10, gives detailed engineering and application data on a system for transmitting pressure measurements electrically with accuracies within ¼ of 1% of reading. Applicable to all process variables such as flow, temperature, pressure, level, density, etc. Automatic Temperature Control Co., Inc.

37—Remote Control Valve

The Valve That Never Fails to Open or Close, Bulletin 800-B; 16 pages describing operating principles and giving applications for manual and automatic remote control of the FLEXFLO expansible tube valve; including diagrams of typical arrangements suitable for stop-valve, flow control, check, and other diversified uses. Grove Regulator Co.

38—Nickel Alloys

Helpful Publications on Nickel Alloys, List "A", gives current publications covering production, fabrication, properties, and uses of nickel alloy steels, nickel cast irons, nickel brass and bronzes, and nickel plating. International Nickel Co., Inc.

39—Plug Valves

Homestead-Reiser "Self-Seald" Lubricated Plug Valves, Reference Book 39—Section 5, gives dimensions, weights, and prices on a line of lubricated plug valves of 150 psi. w. p., semi-steel, straightway, sizes from 1 to 8 in., in screwed or flanged style. Homestead Valve Mfg. Co.

40—New Flow Principle

Bethlehem Flow Tube, a six-page folder combining cut-away views and engineering drawings to describe the Gentile principle of a new flowmetering device; device requires no straight sections of piping, forms low restrictions to normal flow through line, and can be used in either direction. Bethlehem Foundry & Machine Co.

41—Instrument Protection

Taylor Technology, Vol. 1, No. 2; second issue of a new quarterly publication covering the design, development, application, operation, and maintenance of instruments. Of especial interest are articles on purge and seal systems for instrument protection, and how instruments enabled Warren Petroleum Corp. to operate profitably a direct- fired natural gasoline plant without the customary use of steam. Taylor Instrument Cos.

42—Mercury Manometer

High Accuracy Mercury Manometer, Bulletin 98182; describes the new model 1500 Taylor Mercury Manometer, featuring interchangeable range chambers from 10 to 400 in. Hg. Taylor Instrument Cos.

43—Electric Motors

Two-pole, heavy-duty, Squirrel-cage, Induction Motors, Bulletin 1300-PRD-190; describes and illustrates in detail electric motors rated at 200 hp. and larger, 3600 rpm at 60 cycles, and designed primarily for refinery pumps, boiler feed pumps, centrifugal blowers, and compressors. Electric Machinery Mfg. Co.

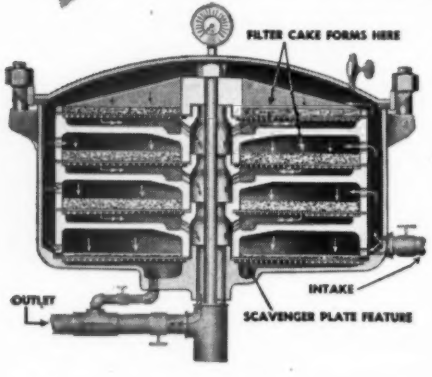
44—Hose Fittings

Quick-as-Wink, Bulletin No. 104-B, covers valve and hose couplings, nipples, and clamps for air, water, and oil hose, including dimensions and prices. C. B. Hunt & Son, Inc.

Sparkler Filters

SPARKLER horizontal plate FILTERS

". . . keep petroleum products clean and free of foreign matter



The Sparkler horizontal plate method of filtration insures a firm, unbroken filter cake formed from diatomaceous earth or other filter media particularly suited to the liquid filtered. Such a filter cake removes even microscopic particles from any liquid ranging from light alcohols to heavy resin products.

The petroleum refining and processing industry have available a filter in the Sparkler that solves many problems of keeping liquid petroleum products free from solids such as scale, rust, grit, and other foreign matter.

Domestic Fuel Oil bulk plant operators can be sure of delivering clean clog-free fuel oil by filtering with Sparkler filters

Sparkler filters are available in capacities from small pilot plant models to built-in production line units of 5000 gallons per hour. The services of our staff of engineers with over a quarter of a century experience in solving filtration problems is available. Your problems will receive personal attention and individual analysis. Write Mr. W. J. Kracklauer, Sec'y & Treas.

SPARKLER MANUFACTURING COMPANY, Mundelein, Illinois

For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 1105. Just circle the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

The spirit that quickeneth

We celebrated Oil Progress Day on October 14th. It is an old American custom on such occasions to point with pride to humble beginnings, present bigness, and the promise of the future.

Since Edwin L. Drake, onetime railroad conductor, in spite of popular ridicule, sank his well in 1859, petroleum has developed into one of the top industries of America. Its working plant is valued at 30 billions of dollars. This plant produces nearly two-thirds of all the world's oil. From its refineries, in constant stream, comes the gasoline that powers the Motor Age. According to government figures, the industry directly and indirectly provides employment for five million men and women.

Thus the case for celebration could rest on size alone. There is also abundant reason to view with enthusiasm the industry's future. Already from its laboratories have come 11,000 by-products from the drop of oil. These useful by-products range from acids to asphalt, from ink to insecticides, from vitamins to velvets, from brushes to building material, from fertilizers to freezing compounds, from resin to rayon, from cocktails to cosmetics. The list grows every day. Whole new industries will spring from this drop of oil. Millions unborn will earn their livelihoods from its magic. For everyone, the luxuries of today will become conveniences, and indeed, necessities, because of these new products from petroleum.

The oil industry, however, has another asset greater than machinery and plants and capital and laboratories. The amazing development of the industry did not come about by accident. It has grown great and serviceable—and will continue to grow — only through the devoted and sacrificial attention and enthusiasms of men and women—of human beings.

The greatest mistake we can make is to act upon the false premise that business is self-starting, is cut and dried routine. Economists boast of our eighty million horsepower on call in our manufacturing plants. Statisticians classify this horsepower as "prime movers," tremendous energy at the turn of a switch or the pull of a throttle. How fantastic! The real "prime-movers" of an expanding economy are men—men of spirit and the capacity to do. It is they alone who sustain the pressure of progress. The spirit of the millions of men and women who are eager to get on and up in the world is the most powerful factor in our business life. We, the people, in our own enlightened self-interest, should see to it that this spirit is not deadened—in petroleum or any other industry—by popular indictments, unwise restrictions, excessive taxation that absorbs risk capital, competition by one's own government.

As the nation celebrates the progressiveness of the oil industry this month, it might well re-dedicate itself to the proposition that America progresses, is kept a going concern, through the spirit and enthusiasm of its business men and women. They are the nation's indispensable resource, the real ambassadors of the more abundant life.

CITIES SERVICE

Quality Petroleum Products

Recover Usable Water from Waste By Extracting Condensable Gases

By JOHN C. ALBRIGHT

A SIMPLE stripping column and accessory equipment, recently installed by Union Oil Co. of California in its Wilmington refinery, for removing hydrogen sulfide and ammonia from plant waste water, is reported to be giving satisfactory service.

Union's refinery is situated on the flank of Palos Verdes Hills overlooking Los Angeles, Long Beach, and San Pedro Harbors. It is near enough to the Pacific Ocean so that cold salt water may be economically pumped through the plant for cooling purposes.

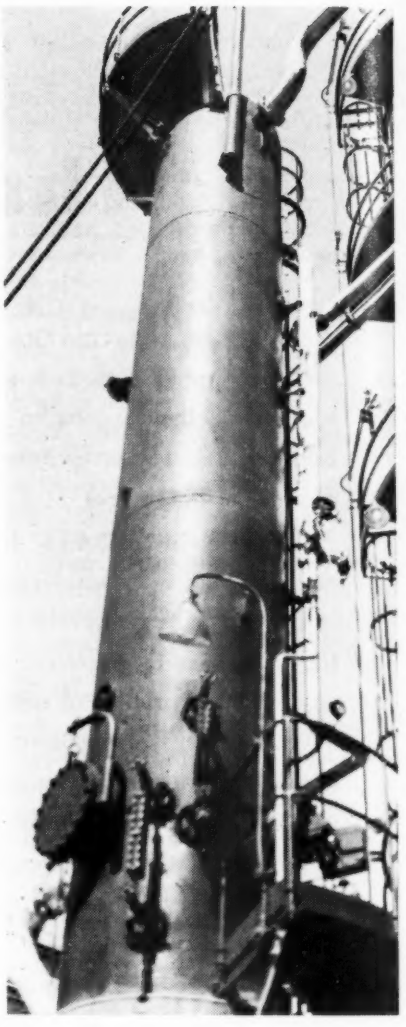
Waste water originally obtained from sources other than cooling is dumped into the disposal system carrying the once-through sea-water back to the Pacific. Column waste water, after ammonia and hydrogen sulfide have been extracted, has the normal characteristics of steam condensate, and has no more harmful influence on harbor installations than so much flood water coming from the seasonal rains.

The process employed to extract H_2S and NH_3 consists of a simple fractionating unit, and is virtually automatic, requiring a minimum of supervision and attention by plant operators.

The various parts include a waste water gathering system, a horizontal accumulator with an interface level transmitter, a duplex reciprocating steam pump with a spare, a conventional design shell-and-tube heat exchanger, a stripping column 4 ft. in diameter by 30 ft. in height containing 12 bubble plates, and an overhead partial condenser from which the contaminants are removed from the system. A flow diagram is shown in Fig. 1, and the stripper in the accompanying photograph.

In operation, waste water flows by gravity through the gathering system to the accumulator. The pump directs the feed through the exchanger to the stripping column. Exchange of heat is accomplished in the shell-and-tube unit, cooling the stripped water, and heating the feed to 220° F. before it enters the stripping column at the midpoint.

Saturated plant steam at 20 psi. is introduced in the base of the stripping column to maintain a column bottom temperature of 240° F. Water vapor from the steam flows upward along with vaporized H_2S and NH_3 to the top of the column, where it is held at a pressure of 8 psi. and a temperature of 227° F. It leaves through a vapor line to a partial condenser cooled by circulated plant water.



Stripper for ammonia and hydrogen sulfide measures 4 ft. diameter by 30 ft. height, contains 12 bubble trays

The recycle or reflux, at 140° F. with a volume of 264 b/d, re-enters the column near the top for two specific reasons: 1) to control the top column temperature and 2) to thoroughly strip residual compounds from the recycle liquid.

Approximately 1400 b/d of waste water, containing 3600 lbs. of H_2S and 4800 lbs. of NH_3 is fed to the stripping column, resulting in a water yield of 1810 b/d from the base of the column. The excess over the charge is accounted for by condensation and accumulation of 410 b/d of water from the process steam introduced in the base of the stripper at a rate of 144,000 lbs./day.

The overhead disposal consists of 3600 lbs of H_2S, 4300 lbs of NH_3, and three b/d of water. Water flowing through the system from the stripping column contains no trace of the hydrogen sulfide, and a small percentage of ammonia, amounting to about 500 lbs./day.

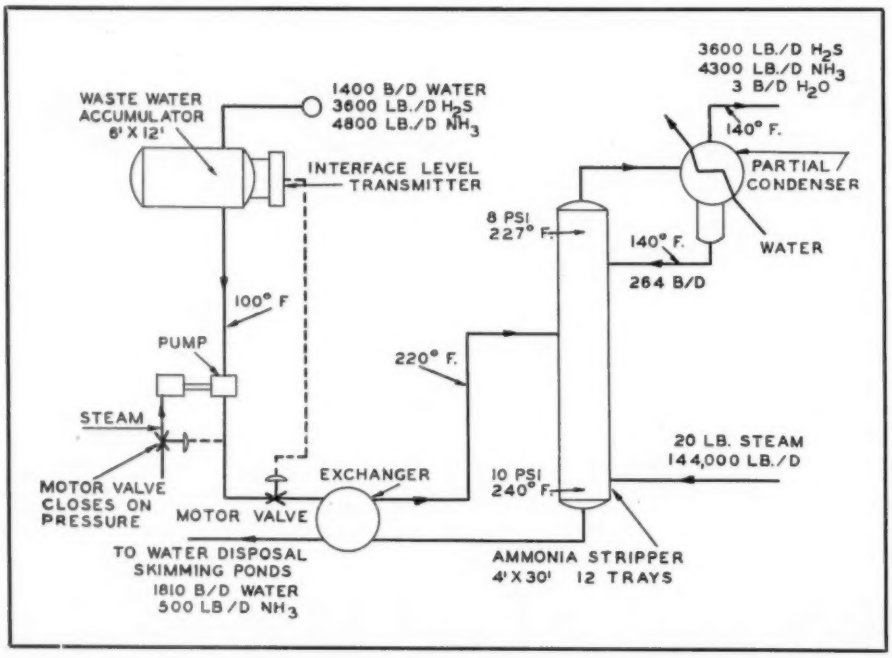
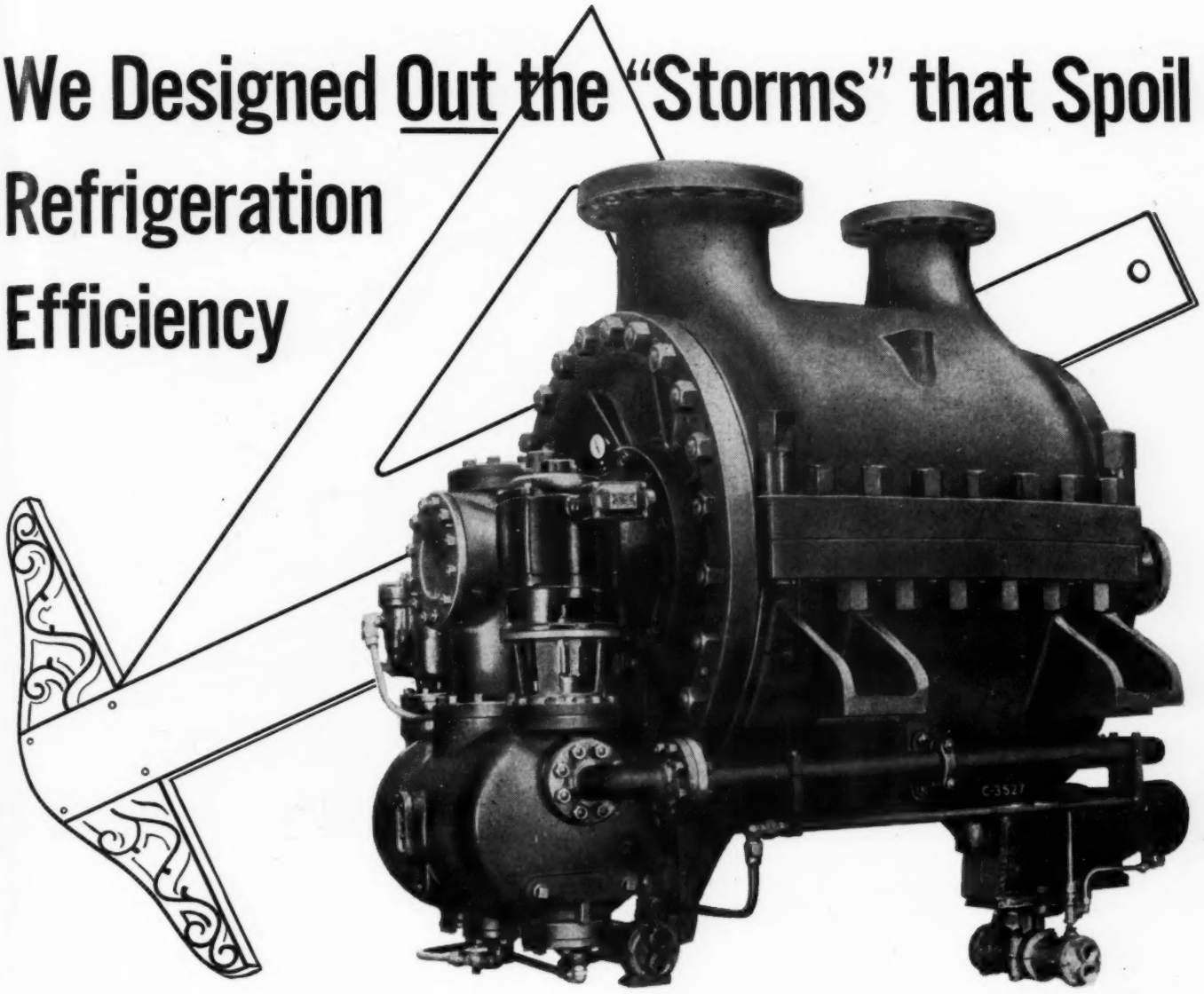


Fig. 1—Flow diagram for Union Oil's waste water treating system, showing operating conditions and material balance

We Designed Out the "Storms" that Spoil Refrigeration Efficiency



The use of "twin volutes" in the design of the Worthington Centrifugal Compressor provides greater efficiency and stability of operation at system design point and partial loads. This is due to the compressor's inherent head-capacity curve flexibility from 120% of full load to 40% of full load capacity without bypass or gas make-up.

Compressors are manufactured to handle loads at single temperature levels or multiple loads at different temperature levels. These loads may be injected between various stages of compression to suit tower levels and through-put.

WIDE RANGE OF REFRIGERANTS, CAPACITIES, PRESSURES, METALS, DRIVES

Worthington Centrifugal Compressors are designed to use any hydro-carbon refrigerant, such as methane, propane, propene, ethane, ethene, isobutane, normal butane, butene and plant mixtures . . . to handle capacities from 1500 to 60,000 cfm, in one unit, at temperature levels from minus 200F to plus 60F and pressures from 100 to 400 psi . . . to be driven by motor, steam turbine, gas or Diesel engine. Casings are made of cast iron, cast steel or nickel steel.

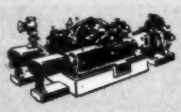
Write for more information which gives further proof that *there's more worth in Worthington,* address *Worthington Pump and Machinery Corp., Harrison, N. J.*

WORTHINGTON

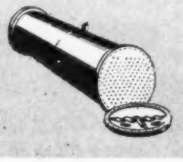
AS-35

FIVE MORE REASONS WHY WORTHINGTON LEADS IN INDUSTRIAL REFRIGERATION

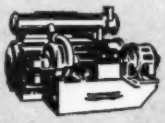
Horizontal compressors for all types of refrigerants



Shell and tube refrigerating equipment



Centrifugal compressors



Absorption refrigerating machines

Chilling machines and exchangers

UP-TO-DATE and READY-TO-GO!

Modern Refinery Equipped to Produce *Avgas..Butylene, Butadiene..Aromatics*

This refinery, built in 1944, is located in Cotton Valley, Webster Parish, Louisiana, about 45 miles northeast of Shreveport. It is reached by State Highway No. 90 and is served by the Louisiana & Arkansas Railway. The site consists of 31.7 acres, with adjoining land available for expansion.

This property is now offered for lease or sale as a whole for use in place.

PRINCIPAL EQUIPMENT

The main units of this refinery are:

(1) Dehydrogenation Unit with capacity of 750 to 1000 barrels per day of butylene, depending upon type of catalyst used.

(2) Alkylation Unit with capacity of 2200 barrels per day of aviation alkylate.

(3) Ethyl Blending Plant.

(4) Storage Tankage, Atmospheric: 191,000 barrels. Pressure: 51,000 barrels.

(5) Loading Rack with 2 sidings.

(6) Cooling Tower, Laboratory, Boiler Plant, Electric Power Generating Plant.

UTILIZATION

While these facilities are presently connected for the production of butylene concentrate, they were originally designed for the production of aviation gasoline and blending components. Their process line characteristics offer two additional potential utilizations:

(1) Production of butylene and butadiene from butane, and

(2) Production of benzene, toluene, xylenes and other aromatics by synthesis from petroleum fractions.

SEALED BIDS for the purchase of this plant are invited. Write now to the address given below for necessary bidding instructions, for an illustrated brochure and for an appointment to inspect this refinery. All interested parties will be notified later as to the cut-off date for the receipt of sealed bids, and are invited to visit this office, located in the North American Plant, Grand Prairie (Dallas), Texas, for the purpose of examining the designs and specifications.

This advertisement is not a basis for negotiations and the Administration reserves the right to consider all proposals in the light of applicable objectives of the Surplus Property Act or to reject any or all bids. Any transfer of title will be subject to Executive Order 9908 relative to fissionable materials.

WAR ASSETS ADMINISTRATION
OFFICE OF REAL PROPERTY DISPOSAL

POST OFFICE BOX 6030 • DALLAS, TEXAS

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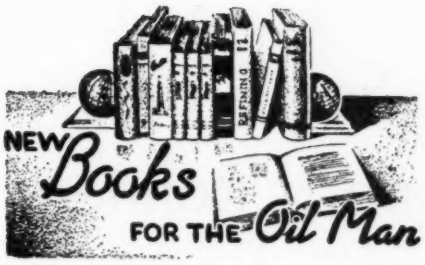


Copies of all books reviewed here may be ordered from the Reader's Service Department, Petroleum Processing, 1213 West Third St., Cleveland 13, for the price listed, postpaid, unless indicated otherwise. Ohio purchasers please add 3% tax

First in Series Issued by A.P.I. On Plant Inspection Practices

Recommended Practices for Refinery Inspections, Part I, Process Equipment; 8 x 10½ in., 104 pages, heavy paper binding, illustrated. $3.00.

The American Petroleum Institute has prepared here the first in a group of manuals devoted to *Recommended Practices for Refinery Inspection.* There will be six parts to the entire volume. Following the present *Part I* on process equipment, there will be: Part II—Pressure-relieving Devices; Part III — Fire-protection Equipment; Part IV—Storage Tanks and Spheroids; Part V—Instruments; and Part VI—Electrical Equipment.

Although arranged in the form of a code as means for convenient reference, the information does not constitute a code of rules or regulations, because "it includes generalized statements and recommendations on matters subject to diverse opinions" according to the foreword. The present manual is intended as a guide for inspection of existing operating equipment and is not intended to be used to govern the purchase of new equipment.

The information presented covers organization of an inspection department, methods of inspection, determination of limits, methods of repair, records and reports, and tools. The appendix comprises a set of illustrations of typical inspection record forms, calipers, and other tools.

It is planned to revise these publications periodically as new and improved practices are developed.

New Chapters in Revised Sachanen Text on Conversion

Conversion of Petroleum, 2nd Edition; by A. N. Sachanen; 6 x 9 in., 614 pages, stiff cloth binding, illustrated, indexed, $11.00.

Many important developments in refining technology have taken place since the first edition of *Conversion of Petroleum* appeared in 1940 — notably catalytic cracking, alkylation, polyforming, catalytic isomerization, hydroforming and dehydrogenation. As a result this work has been quite thoroughly revised. Newly written special chapters are devoted to the conversion of petroleum gases into motor fuel and catalytic cracking. Other sections of the book, particularly Chapter 1 on reactions of hydrocarbons, and Chapter 7 on synthetic gasolines, have been revised and supplemented by new data.

In the main, the volume is a text on processes rather than engineering of the various processing units. Considerable data are presented on up-to-date information regarding operating results, yields and the like. However, some cost comparisons and information on non-catalytic cracking are given in the chapter devoted to that subject.

Dr. Sachanen is associated with the research and development division of Socony-Vacuum Oil Co., Inc., at Paulsboro, N. J. Born in Finland, he received his formal education in Russia, and has had experience in refining of petroleum in Russia, Finland, and France before coming to this country in 1935.

Skinner Compiles 39th Issue Of British Petroleum Year Book

Oil and Petroleum Year Book, 1948, compiled by Walter E. Skinner; 5¼ x 8 in., 236 pages.

This British reference work, *Oil and Petroleum Year Book,* is now in the 39th year of publication. It presents the following information on 660 oil companies operating in all parts of the world and covering all branches of the industry: names of directors and other officials, where operating, description of business, crude oil production, refinery runs, details of capital, dividends, and financial results. Other information includes the names and addresses of 352 managers and engineers and the companies listed in the book with which they are connected. Copies of the book can be obtained from the compiler and publisher, Walter E. Skinner, 20 Copthall Ave., London E. C. 2, England, at $4.00 net, post free abroad.

Pictures Tell Pioneering Story Of Oil in Western Pennsylvania

Early Days of Oil, by Paul H. Giddens; 8½ x 11 in., 150 pages, stiff cloth binding, illustrated, indexed, $6.00.

A photographic narrative of life in western Pennsylvania during the fascinating development of the oil industry from 1860 through 1892 is told in *Early Days of Oil,* which comprises some 365 pictures selected from a huge collection taken by John A. Mather.

Early wells, primitive equipment, transportation difficulties, boom towns, and disasters were all recorded by Mather, who made his headquarters in historic Titusville, but followed the pioneer oil men everywhere, developing his negatives in horse drawn wagon or houseboat. How many pictures he took is not known, but in the Titusville fire and flood of 1892 he lost over 16,000 negatives. About 3,000 were saved and today are preserved at the Drake Museum. This pictorial history of the beginnings of the industry is composed of a selection from the Museum's collection.

The author, Curator of the Drake Museum at Titusville and Chairman of the Department of History at Allegheny College at Meadville, is well-known for his book *Birth of the Oil Industry.*

Hydrofluoric Acid Safety

Hydrofluoric Acid, Chemical Safety Data Sheet SD-25; 8¼ x 10¾ in., 20 pages, perforated for loose-leaf binding, gives physical and chemical properties of hydrofluoric acid, usual shipping containers, methods of unloading and emptying, container storage and handling, requirements for caution labels, and recommended personal protective equipment. A section on health hazards and their control has been covered authoritatively by the Medical Advisory Committee of the Manufacturing Chemists' Association. Copies may be obtained at 20c each from the Manufacturing Chemists' Association, Inc., 246 Woodward Bldg., Washington 5, D. C. Remittance should be sent with each order.

MEETINGS . . . for the Oil Man

NOVEMBER

4-5, Society of Automotive Engineers, Fuels and Lubricants Division, Mayo Hotel, Tulsa.
7-10, American Institute of Chemical Engineers, Pennsylvania Hotel, New York.
8-11, American Petroleum Institute, annual meeting, Stevens Hotel, Chicago.
13-16, American Society for Testing Materials, Committee D-2 on Petroleum Products and Lubricants, Drake Hotel, Chicago.
15-18, American Oil Chemists Society, fall meeting and technical sessions, Pennsylvania Hotel, New York.
28-Dec. 3, American Society of Mechanical Engineers, annual meeting, New York.

DECEMBER

9, Chemical Market Research Assn., Toronto, Canada.
12-13, American Chemical Society, 3rd Southwestern Regional Meeting, Houston.
29-30, American Chemical Society, Division of Industrial and Engineering Chemistry, Symposium on Heat Transmission, Chicago.

JANUARY, 1949

10-14, Society of Automotive Engineers, Annual Meeting and Engineering Display, Book-Cadillac Hotel, Detroit.

FEBRUARY, 1949

10, Chemical Market Research Assn., Biltmore Hotel, New York.
28-Mar. 4, American Society for Testing Materials, Spring Meeting and Committee Week, Hotel Edgewater Beach, Chicago.

Equipment Men See Products In Use in a Modern Refinery

THIRD tour of a petroleum processing plant by representatives of equipment manufacturers and their advertising agencies to learn how their products are used in modern refining operations took place at Sun Oil Co.'s 135,000 b/d refinery at Marcus Hook, Pa., October 7.

A total of 59 guests were guided through the plant by engineers and operating executives of Sun, co-sponsors with PETROLEUM PROCESSING of the tour. First such trip took place May 25 when the magazine and Esso Standard Oil Co. were hosts to 72 at Esso's Bayway, N. J., refinery. A second tour at the Whiting, Ind., plant of Standard Oil Co. (Indiana) brought a glimpse of today's petroleum technology to 114 from the greater Chicago area.

Primary object of the tour is to provide equipment men with the opportunity to observe how their equipment is used, and to hear directly from refinery management how the equipment is selected and applied. On arrival at Marcus Hook, guests, who came from Philadelphia, Wilmington, New York City, and surrounding areas, were welcomed by A. W. MacMurtrie, refinery manager.

Dr. J. Bennett Hill, Sun's Director of Research, then explained the fundamentals of petroleum processing, illustrating his talk with simplified flow diagrams. The guests at this point split up into three groups. Those interested in vessels and large equipment were shown that type of equipment; those whose products followed such lines as pumps, valves, fittings, and the like saw similar equipment in operation; and those from the instrument industry were shown Sun's maze of indicating, control, and recording devices.

After lunch in the company cafeteria, the group reassembled to hear Sun's chief engineer, Paul D. Barton, tell how equipment is selected. A special description of the work behind the choice of proper metals was given by Dr. A. F. Bagsar, chief metallurgist for Sun.

A total of 30 manufacturers and five advertising agencies were represented by the men in the tour. They were:

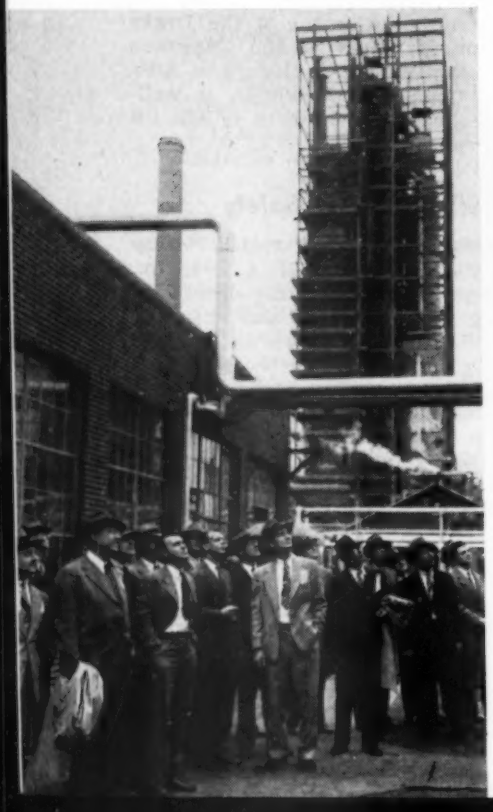
A. E. Aldridge Associates, A. E. Aldridge, Walter Werbos; Ampco Metal Inc., J. E. Cook; N. W. Ayer & Son, C. C. Gates; Baldwin Hill, James Heermance; Bonney Forge & Tool Works, Joseph M. Potts, D. D. Williams, Jr.; Bristol Co., L. E. Mustard, E. L. Stilson; Brown Instrument, R. W. T. Ricker, J. F. Sullivan; Carbide & Carbon Chemicals, J. M. Russ, Jr.; Catalytic Construction, J. Gerner, H. Kiel, J. McFarlin.

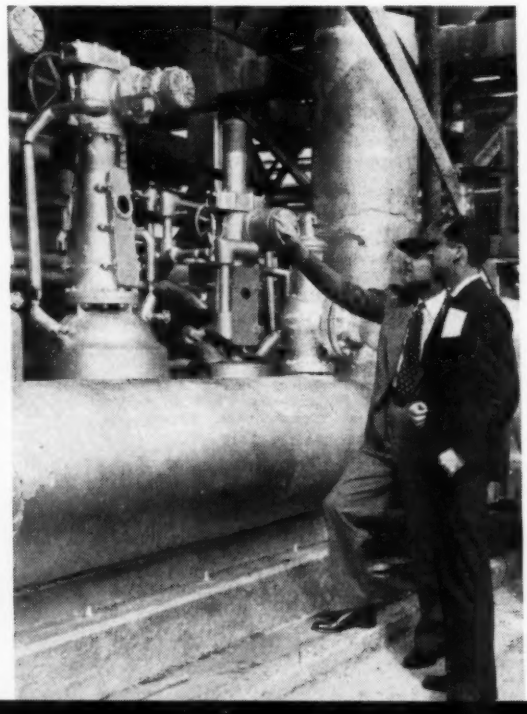
E. I. du Pont de Nemours, R. C. Sickler; Fischer & Porter, P. Berg; Gray & Rogers, Peter M. Madeira; Hammond Iron Works, E. H. Bodinson; Hercules Powder Co., G. F. Dittmar; International Nickel Co., John Kolb, Donald Larmett, M. J. Phillips, Brant W. Weathers; Leeds & Northrup, R. N. Brey, K. W. Conners, E. C. Wood; Linde Air Products, L. F. Granger; R. E. Lovekin Corp., G. Gould, R. E. Lovekin, R. E. Lovekin, Jr., N. Meyer; Lukens Steel, Daniel T. Brigham.

Manning, Maxwell & Moore, L. E. Gebhardt, G. E. Keating; McLain Organization, L. R. Cook; National Airoil, Edward P. Bailey, Frederic Bauer; Norton Co., Robert P. Anderson, Russell L. Peck, Harlan T. Pierpont, Jr.; Penna. Salt Mfg. Co., Vincent Curll, Bryce Gray, Jr.; Philadelphia Gear Works, H. L. Murray; Rockwood Sprinkler Co., A. H. O'Connell.

R. S. Products, R. C. Ayer, E. Zwicker; Selas Corp. of America, K. W. Fleisher; Solvay Sales, R. E. Lowes, William Ridpath; United Engineers & Construction, T. J. Reyn-

Feature of tour was showing equipment of primary interest to each of three groups to which guests had been assigned. For example: at left; the vessels and structures group inspects Houdry catalytic cracking unit with a Thermofor catalytic cracking unit in the background. Center; Assistant Superintendent W. T. Askew explains motor-operated valves in Houdry unit. Right; Chief Instrument Engineer E. J. Grace demonstrates use of indicators in lube plant





IF YOU EMPLOY 100 PEOPLE OR MORE...

YOU CAN MAKE THESE YOUR *Success Stories!*

Payroll Plan for U. S. Savings Bonds actually increases worker production, as demonstrated in large and medium-sized companies throughout the nation. Here are some examples:

PAYROLL SAVINGS MAKES EMPLOYEES MORE CONTENTED

In General Motors' My Job Contest, approximately 15,000 GM men and women gave the Payroll Savings Plan as one of the reasons they like their jobs!

PAYROLL SAVINGS CUTS ABSENTEEISM

A survey made by a smaller company in Minnesota showed that during a recent three-month period employees not on payroll savings were absent almost 2½ times more frequently than those who were on the Payroll Savings Plan. Further proof that payroll savings cuts absenteeism!

PAYROLL SAVINGS REDUCES ACCIDENTS

Records at our eleven Navy Yards show that, as participation in the Bond program increases, accident frequency and accident severity decline. When participation at the Norfolk Navy Yard climbed to over 90%, accident frequency declined over 50%, and the accident severity index dropped to 1/6 its former level!

Hundreds of companies are reporting benefits like these! Obviously, they add up to increased production.

What's more, the Payroll Savings Plan is a powerful weapon against inflation. Every Savings Bond dollar built up in the Treasury retires a dollar of the national debt that is potentially inflationary. That's good for the country's future—which means it's good for *your company's* future.

And, of course, it's good for the employee's future, because the Bonds pay $4 at maturity for every $3 invested.

If your company has the Payroll Savings Plan, make sure you and your employees are getting the most out of it! If you haven't yet installed the Plan, you're missing something! For facts or help, call your Treasury Department's State Director, Savings Bonds Division.

The Treasury Department acknowledges with appreciation the publication of this message by

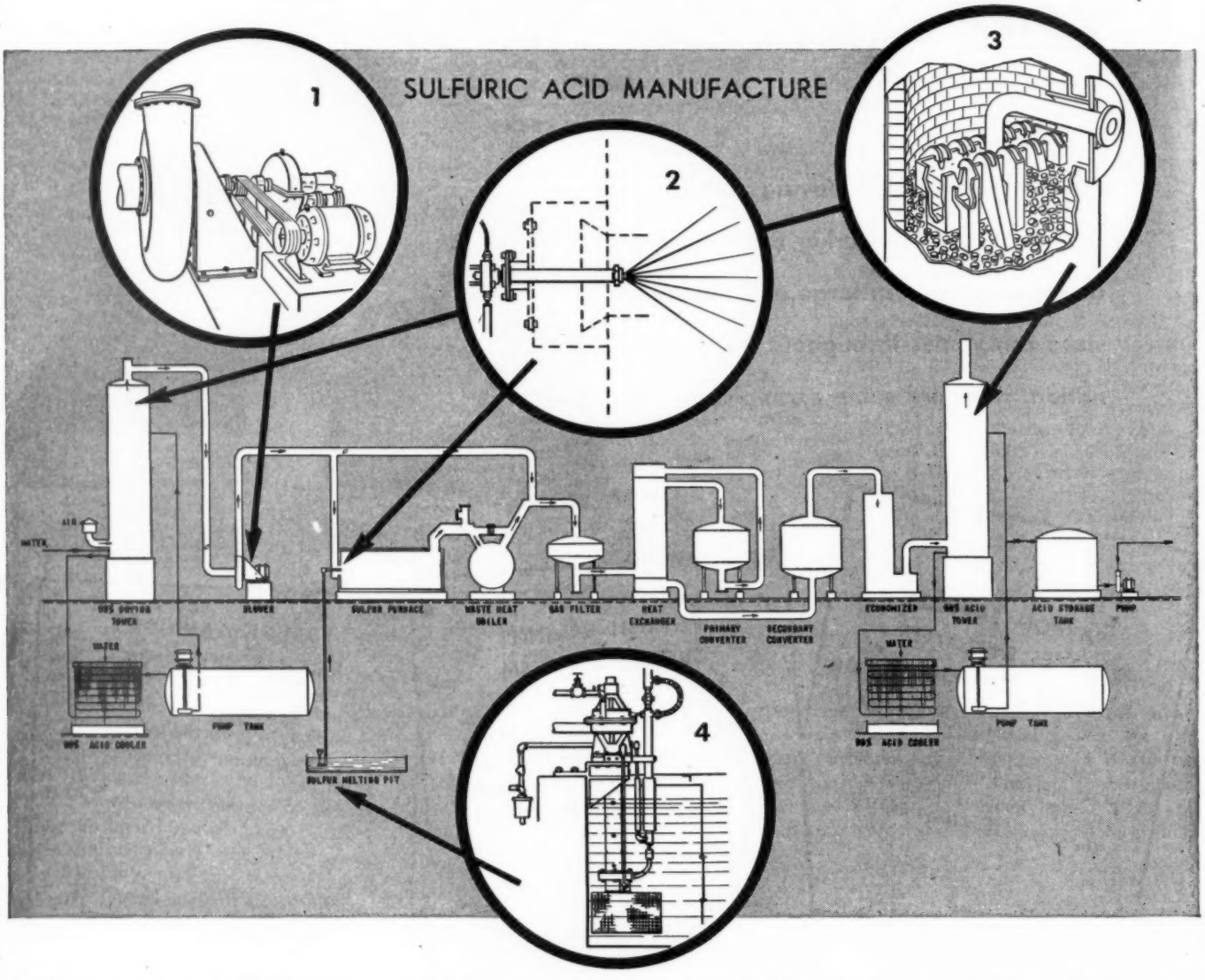
PETROLEUM PROCESSING

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and the Advertising Council.

Chemico Design Features

. . . that increase operating efficiency in a

CONTACT ACID PLANT



Chemico-designed plants have many unusual features of original design which add to operating efficiency. In a Chemico Contact Sulfuric Acid Plant, for instance, you will find these important improvements:

1. Electric motor starting for main blower until steam from waste heat boiler is available to operate the steam turbine.

2. Sulfur gun that sprays liquid sulfur into the furnace under controlled conditions to produce uniform strength SO_2 gas without sublimation.

3. Highly efficient distributors that assure effective contact of acid and gas without carry-over of acid mist.

4. Steam turbine driven submerged sulfur pump that delivers a steady supply of liquid sulfur to the burner.

Properly designed equipment combined with the *right process* is your assurance of trouble-free operation and maximum production in a Chemico-built acid plant.

Chemico Plants are profitable investments

CHEMICAL CONSTRUCTION CORPORATION

EMPIRE STATE BLDG., 350 FIFTH AVENUE, NEW YORK 1, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE
CYANAMID PRODUCTS, LTD., BRETTENHAM HOUSE, LANCASTER PLACE, LONDON W. C. 2, ENGLAND
CABLES: CHEMICONST, NEW YORK

CC-170

olds; Walworth Co., G. R. Thompson, Ralph Tierney; C. H. Wheeler Mfg., George C. Long, William H. Rullman; Worthington Pump, R. K. Grobholz, T. E. McVicker; Yarnall-Waring, A. L. Aicher, and H. C. Woodward.

Personnel Changes

Kieley & Mueller, Inc.—Al Bailey new general manager, to headquarters at plant in North Bergen, N. J.

Wolverine Tube Div., Calumet & Hecla Consolidated Copper Co., Inc.—E. J. Campbell, to ass't manager of Mid-Western sales, at Chicago office —S. C. Seekell succeeds Campbell as sales representative in Grand Rapids, Mich.

Nopco Chemical Co. — John J. McCloskey, Jr., as sales representative in Central Atlantic states, and John J. Ryan, in Eastern Area states; to handle Nopco line and also products of **Metasap Chemical Co.**, a wholly-owned subsidiary.

Monsanto Chemical Co. — Executive committee increased to five members; additions are Vice-Presidents Osborne Bezanson and R. R. Cole—Vice-President Francis J. Curtis continues as secretary of Executive Committee and takes on new position of Sales Coordinator—Vice President Carrol A. Hochwalt becomes also Research & Development Coordinator—Fred G. Gronemeyer to newly-created post of Chief Engineer of Organic Chemicals Division.

Allis-Chalmers — B. F. Bilsland to manager of newly-formed Midwest region, succeeded as Chicago district manager by J. C. Collier.

Taylor Forge & Pipe Works—Robert W. Vilsack to sales department, reporting at main plant in Chicago.

Stacey-Dresser Engineering—O. E. McCullough, Jr., as district sales manager with offices in Praetorian Building, Dallas, Texas.

Branches, Distributors

Process Equipment Department of Union Iron Works has appointed Chemical Pump & Equipment Corp., 75 West Street, New York 6, N. Y., as representatives in territory comprising western Connecticut and New York state east of Rochester. Staff of chemical and mechanical engineers is available for consultant services.

Foxboro Co., Houston branch, was scheduled to move from Sterling Bldg. to a new building at 2518 South Blvd., on October 15. New structure, on one floor level, is on a site 13,000 sq. ft. in area, and will provide facilities for sales and service as well as warehousing and parking accommodations. Leo W. Parten, district manager, continues in charge.

Kieley & Mueller announce appointment of Charles W. Snyder Co., Inc., as mid-continent distributor, located at 1001 North Wheeling St., Tulsa 6, Okla.

Hammel-Dahl Co. has new Dealer Representative in Arduser & Co., at Tulsa, Okla., headed by H. W. (Doc) Arduser.

Expansion, Transition

Brown Instrument Co., division of Minneapolis-Honeywell Regulator Co., announces three-year program for expansion of development and production operations as second step in company's $2,500,000 physical expansion. First part of program was hiring of 40 newly graduated engineers, and represents immediate growth in development engineering department by 30% and in application, industrial, and general engineering by 10%.

Resinous Products & Chemical Co. —**Rohm & Haas Co.** merger has been approved by stockholders of both companies.

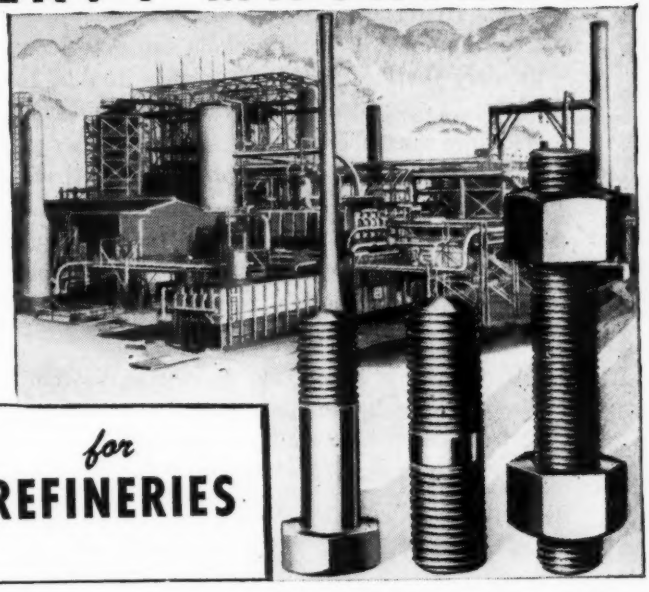
Koppers Co., Inc., Engineering & Construction Division, has set up a new Chemical Section to supervise and coordinate engineering and construction work on contracts secured for the erection of plants to produce synthetic fuels, oxygen, and certain chemicals. Heading up the new section will be T. M. Osborne, who has been project manager on Koppers' contract to build a $4,500,000 synthetic fuels plant for the government at Louisiana, Mo. Before joining Koppers about a year ago, Osborne was a Brigadier General in the U. S. Army Corps of Engineers.

Clark Bros. Co., Inc., has entered into a joint agreement with **Frederic Flader, Inc.**, whereby Clark will manufacture and distribute gas turbines and axial compressors of the Flader design, with Flader responsible for research, engineering and design.

Trinity Equipment Corp. has announced the consolidation of its general offices and factory in a new and completely modern building at 472 Westfield Ave. East, Roselle Park, N. J. The new plant will be devoted exclusively to the manufacture of thermowells and metal specialities for the process industry.

ERIE SPECIAL BOLTING FOR HEAVY MACHINERY

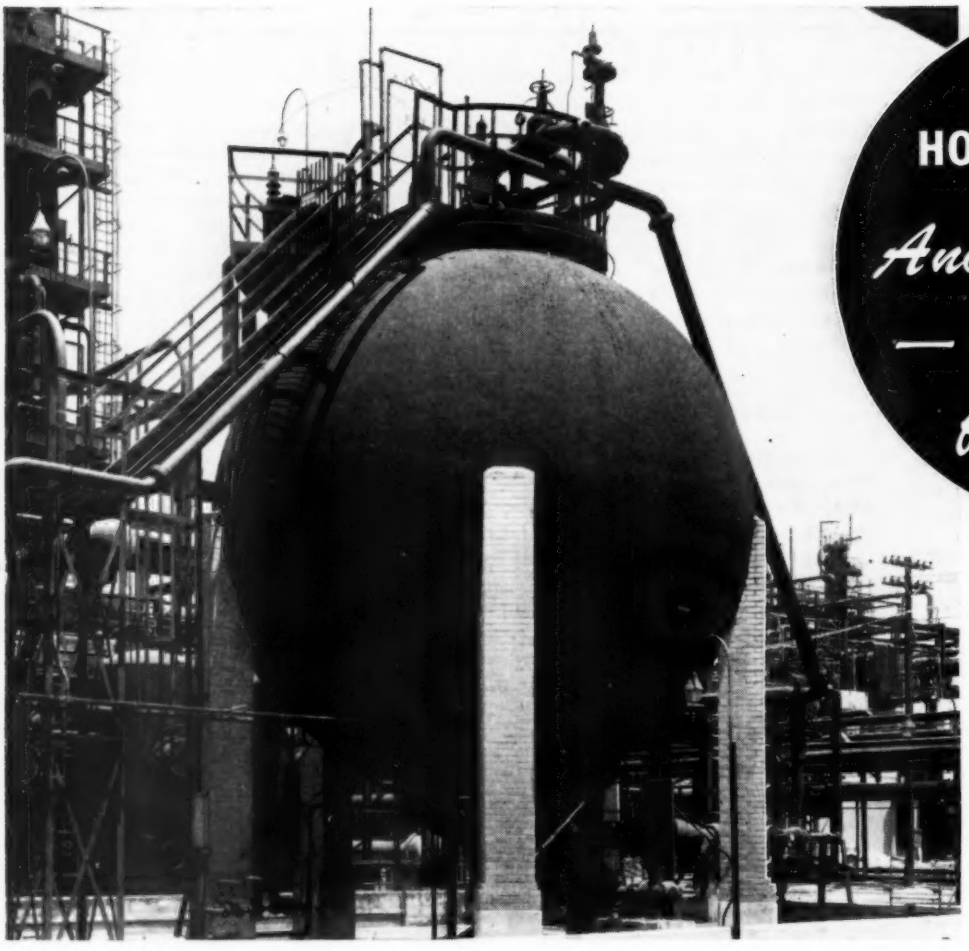
FOR over 30 years ERIE has specialized in the manufacture of *high quality bolting*. We use the very latest equipment for heat treating, machining, grinding and threading. We are certain that we can produce better bolting at a saving to you because we are specialists — send us your bolting specification for our estimate.



for REFINERIES

A DEPENDABLE SOURCE OF HIGH QUALITY BOLTING FOR RAILROADS, REFINERIES, DIESELS, FARM MACHINERY, EXCAVATING EQUIPMENT AND ALL TYPES OF HEAVY MACHINERY.

ERIE BOLT & NUT CO.
ERIE, PA.
A SUBSIDIARY OF Barium STEEL CORPORATION Steelweight to the Nation
STUDS • BOLTS • NUTS ~ ~ ALLOYS • STAINLESS • CARBON • BRONZE



THE HORTONSPHERE

Another new job — and looking for more!

THE crude oil desalter shown above, known as the ELECTROSPHERE, is a combination of electric desalting equipment and a 22 ft. diam. HORTONSPHERE—the familiar pressure container used throughout the petroleum industry for the storage of volatile liquids. In addition to petroleum storage, the Hortonsphere also does a number of jobs in other industries, storing such products as hydrogen, anhydrous ammonia, and carbon monoxide. The advantages of this versatile storage tank include simplicity and dependability of operation, low maintenance cost, minimum interior corrosion, and very low fire hazard.

If you have a problem in storing or handling volatile liquids, consider the use of the Hortonsphere. For full information, call or write our nearest office.

Desalter Prepares Crude Oil for Refining Units

The electric desalting process removes approximately 90 per cent of the salt from crude oil. This—

1. Reduces the salt accumulation in refining units.

2. Cuts down the corrosion from evolved HCl.

3. Keeps sand, silt, rust and slugs of water from entering refinery units with the crude.

4. Prevents formation of hard, flinty coke in furnaces.

By using the Electrosphere, refineries are able to operate for longer periods with less down time. Heat exchange efficiency is increased and higher furnace temperatures can be used for deeper cracking.

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Atlanta 3 .....2103 Healey Building
Birmingham 1 .....1527 North Fiftieth Street
Boston 10.....1029-201 Devonshire Street
Chicago 4 .....2114 McCormick Building
Cleveland 15 .....2215 Guildhall Building
Detroit 26 .....1532 Lafayette Building
Houston 2 ....2130 National Standard Building
Havana .....402 Abreu Building
Los Angeles 14 .....1426 Wm. Fox Building
New York 6.....3310-165 Broadway Building
Philadelphia 3 ..1630-1700 Walnut St. Building
Salt Lake City 1 1530 First Security Bk. Building
San Francisco 11 ..1208-22 Battery St. Building
Seattle 1 .....1330 Stuart Building
Tulsa 3 .....1620 Hunt Building

REPRESENTATIVES AND LICENSEES

Horton Steel Works, Limited, Fort Erie, Ontario, Canada
Ateliers et Chantiers de la Seine Maritime, Paris, France
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Compania Tecnica Industrie Petroli, S.A. I. Rome, Italy
Leopoldo Sol & Cia, Reconquista 558, Buenos Aires, Argentina.
Chicago Bridge & Iron Company, Limited, Apartado 1348, Caracas, Venezuela
Whessoe, Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland

PERSONALS

Petroleum Technologists in the Headlines

Wayne E. Kuhn, manager of the technical and research division of The Texas Co., New York, is chairman of the Division of Petroleum Chemistry of the American Chemical Society, succeeding **Dr. Gustav Egloff,** director of research, Universal Oil Products Co., Chicago. Dr. Kuhn was elected at the meeting of the Division in St. Louis Sept. 8.

Mr. Kuhn

Mr. O'Kelly

Arlie A. O'Kelly, associate director of research, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J., is the new vice-chairman of the Division. **C. G. Kirkbride,** laboratory director of Houdry Process Corp., Marcus Hook, Pa., was re-elected secretary-treasurer.

Bernard H. Shoemaker, assistant research director, Standard Oil Co. (Indiana), Whiting, and **L. U. Franklin,** assistant chief chemist, Gulf Oil Corp., Port Arthur, Texas, are new members of the executive committee of the ACS Petroleum Division.

A native of Wisconsin, Dr. Kuhn received his early schooling in Portland, Ore., and obtained his A.B. degree from Reed College, in Portland, in 1925. The next four years he studied in Cornell University, receiving his Ph.D. in 1929 and meantime serving as assistant instructor there. He joined The Texas Co. at Bayonne, N. J. soon afterwards and was transferred to its Port Arthur, Texas, laboratory, where he held various posts until 1937, when he returned to New York. In August, 1938, he was made assistant manager of its technical and research division, becoming manager a short time later.

Dr. O'Kelly received his B.A. degree from the University of Arkansas in 1926. He transferred to the University of Colorado as laboratory instructor and received his Ph.D. in chemistry from that institution in 1929. He engaged in teaching in his profession until 1935, when he became a research chemist for Socony-Vacuum. In 1944 he became supervising chemist in charge of chemical research for the company and in 1937 became associate director of its research and development department.

* * *

C. Z. Hardwick, vice president and manager of refining and marketing operations, Ohio Oil Co., Findlay, O., has been elected to its board of directors. He joined the company in 1921 as a clerk in its Haynesville, La., office and advanced through various executive posts in the refining and marketing division and was elected a vice president in 1945.

* * *

Robert E. Wilson, chairman of the board, Standard Oil Co. (Indiana) has been named chairman of the Committee on Research of the API Board of Directors. He succeeds the late **Harry C. Wiess.**

* * *

Howard Montgomery, manager of terminals for Warren Petroleum Corp., Houston, has been appointed chairman of the technical committee of the Natural Gasoline Assn. of America. Vice chairman of the committee is **Joe F. Wood,** research engineer, Skelly Oil Co., Pawhuska, Okla. Committee agenda for the year includes revisions in the current NGAA standard specifications and test methods for LP-gases and investigation of existing field methods for determining the volume of individual hydrocarbons in wet natural gases.

* * *

Robert H. Andrews is assistant to the president of Houdry Process Corp. and will also serve as assistant secretary and treasurer. He began his oil career with Humble Oil & Refining Co. and during the war was a Lieutenant Colonel in Ordnance.

* * *

E. R. Baker is manager of Continental Oil Co's newly-created central research laboratories. He was formerly director of development for Emery Industries, Inc., Cincinnati, and during the war was assistant chief of the technical division of Chemical Warfare Service.

* * *

William Argyle is executive vice president in charge of manufacturing and a director of Sinclair Refining Co., succeeding **George H. Taber, Jr.,** who has retired. A native of Utah, he graduated from the University of Utah in 1915 and joined the staff of the U. S. Bureau of Mines, serving as assistant physicist until 1920. He then joined the Sinclair organization and was in charge of fuel and utilities covering all operations in its refineries. In 1924 he became superintendent of the company's Marcus Hook refinery and remained at Marcus Hook in complete charge of operations until 1943 when he took leave of absence to become assistant director of refining for PAW, later becoming associate director of refining at PAW.

Mr. Argyle

In 1945 Mr. Argyle returned to Sinclair as assistant manager of refining at New York, and Oct. 1 he was elected vice president in charge of manufacturing and director.

* * *

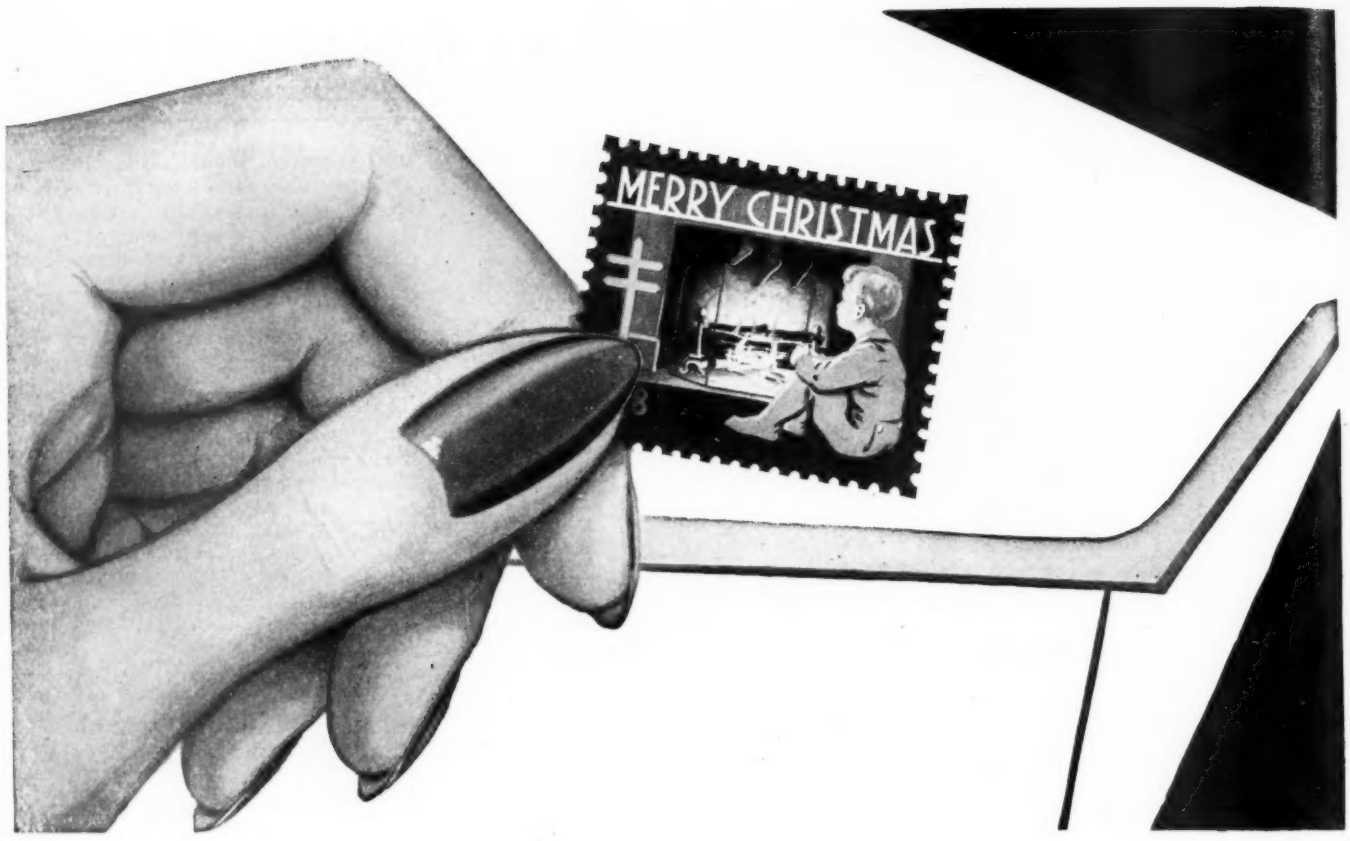
Virden W. Wilson, Houston, has been advanced from the position of chief technologist to chief chemist in charge of Shell Chemical Corp.'s Houston plant laboratories. His first position with Shell Chemical was in Houston in 1946 as a senior technologist. He graduated from the University of North Dakota in 1932, and in 1933 completed his Master's work at the University of Oklahoma, in chemistry and physics. He spent the next two years with Phillips Petroleum Co., at Bartlesville, then a year with Union Oil Co. of California at Wilmington, four years with Buffalo Electro-Chemical Co., Buffalo, and the last 5½ years before joining Shell with The Texas Co., New York, in its managerial department.

* * *

George W. Beste, recently made manager of Ethyl Corp.'s development section, has been with the company since 1940 and previously held the position of supervisor in the development section. He was a member of the Oil and Chemical Division

Posthumous Award

Harry C. Wiess, president of Humble Oil & Refining Co. who died Aug. 26 in Houston, has been posthumously awarded the Charles F. Rand Medal for 1949 by the American Institute of Mining and Metallurgical Engineers. The award is in recognition of distinguished achievement in mining administration and the citation read in part: "For high courage and vision in services to the petroleum industry and for ceaseless efforts in fostering during World War II the production of strategic supplies.'



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Because of the importance of the above message, this space has been contributed by

PETROLEUM PROCESSING

of the U. S. Strategic Bombing survey which studied plant installations in Japan at the end of the war.

* * *

Nels E. Sylvander, formerly research engineer with the Engineering Research Institute, University of Michigan at Ann Arbor, is now associated with Pittsburgh Consolidation Coal Co., Research and Development Division, at Library, Pa., as the coordinating engineer on coal gasification development work.

* * *

Dr. Delma Wells Caldwell is medical director of Standard Oil Development Co., New York. He is a former member of the medical department of International Harvester Co. and a faculty member of Northwestern University, Chicago.

* * *

Wendell P. Lake, chief chemist, Derby Oil Co., Wichita, Kans., is chairman of the Wichita section of the American Chemical Society, succeeding **Dr. Luther L. Lyon,** of the Wichita Foundation for Industrial Research.

* * *

Dr. Lester M. Goldsmith, chief engineer of Atlantic Refining Co., has been awarded the President's Certificate of Merit for outstanding services during the war. The citation was presented at a ceremony held on Oct. 14 at the Franklin Institute in Philadelphia.

The award was approved "in recognition of your outstanding services from October, 1942, to December, 1944, as a member of the Transportation Division of the National Defense Research Committee, Office of Scientific Research and Development, which proved to be an invaluable contribution to the war effort of the United States." Dr. Goldsmith was one of 10 residents in the Philadelphia area to receive this award.

This is the second time Dr. Goldsmith has been honored for his war services. In April, 1947, he was presented the decoration for Exceptional Civilian Service for his contributions in the installation of an oil pipeline under the English Channel—the famed "Operation Pluto."

* * *

Sylvan B. Schapiro has been appointed general superintendent at Pan American Refining Corp.'s Texas City refinery, succeeding **Dr. H. J. Broderson,** who retired last month. Mr. Schapiro has been with Pan American since 1925, and at Texas City since 1933. Prior to his present promotion he was assistant general superintendent in charge of engineering, maintenance and plant utilities.

CLASSIFIED

Petroleum Processing announces this classified section as a regular feature for the convenience of its readers. Classified rates are shown in the accompanying box.

Classified Rates

"For Sale," "Wanted to Buy," Help Wanted," "Business Opportunities," "Miscellaneous" classifications, set in type this size without border—20 cents a word. Minimum charge, $5.00 per insertion.

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Advertisements set in special type or with border—$7.00 per column inch.

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EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

U.S.-British Oil Measurement Project Reaching the Pay Stage

THE AMERICAN AND BRITISH technologists who launched, more than a decade ago, a joint undertaking to standardize volume measurement procedures to facilitate trade in petroleum products between the two countries could hardly have foreseen the importance of their work, which is just now coming to fruition. (See article pg. 1045)

In the intervening years the volume of international trade in petroleum has greatly expanded. The trend of supply and demand for crude oil has been reversed, to make this country an importer of crude in large volume. These conditions have served to make oil companies here more conscious of the divergent oil measurement practices in other countries and of the desirability of bringing about uniformity wherever practicable.

In this intervening period also this country and Britain have borne the brunt of supplying petroleum products for their needs and those of their allies in a world armed conflict. They will have to carry this burden in another war in the foreseeable future. There is a growing realization in oil company circles and government agencies in both countries of the need for arriving at uniform trade practices for their petroleum commerce, both as a preparedness step and to further peacetime trade. The present fundamental work of standardizing tank strapping, gaging, sampling, and temperature determination practices and of arriving at mutually acceptable methods for the correlation of the volume correction and conversion systems used in various countries is an important step in this direction.

However, the oil measurement standardization program is of wider significance than only to oil companies engaged in foreign trade. In this country, under the direction of a special sub-committee of oil company technologists of Committee D-2 on Petroleum Products and Lubricants of the ASTM, technical problems have been taken up as part of the project which at present are given little attention in actual oil company volume measurement procedures, but which affect the accuracy of calculations. To give one example, the calculation of increases in tank capacity due to thermal expansion of the tank metal and those due to liquid heads.

In the U. S. the oil companies have had for many years the benefit of the API Code for Measuring, Sampling and Testing of Crude Oil. The principles in the code for crude apply equally for petroleum products. However, the wide range in the characteristics of products handled today, the new types of tanks for products, among other factors, has made it desirable to work out separately the detailed techniques of methods used in the volume measurement of products, as part of the joint oil measurement standardization program. The methods arrived at will prove valuable to oil companies in the handling of volume products.

In England the joint project is under the direction of the British Institute of Petroleum, which promulgates test methods in the same manner as the ASTM in this country. Undoubtedly the measurement practices and conversion methods arrived at will be applied in the petroleum products trade there.

However, the chief benefit of the joint oil measurement project will be to secure greater uniformity in practices of the two countries connected with handling petroleum products in volume and it is hoped that other projects to this end will be undertaken.

Research Laboratories Symbols Of Future "Oil Progress Days"

IT WAS MOST FITTING that the Esso Research Center of the Standard Oil Development Co. should be formally presented to the public on Oil Progress Day. Certainly this modern office and laboratory building, equipped with the latest in scientific testing equipment, staffed by 750 chemists, physicists, engineers and service personnel, typifies the rapid technological progress in the petroleum industry. The present building also is only one unit of a proposed $8,000,000 expansion of research facilities by this company alone.

However, to most of the 400 leaders in government, industry, science and education who toured the Research Center on Oct. 14, this institution has wider significance than in denoting the industry's progress to date. Work to be carried on there, in addition to fuels and lubricants from petroleum, includes new plastics, paint ingredients, detergents, process oils, insecticides, farm specialties, basic chemicals and others—all from petroleum. From the achievements in this work will come the commercial developments of the future.

E. V. Murphree, president of Standard Oil Development Co., summed up the part that industrial research plays in industry progress in his talk at the opening of the Research Center. Speaking of our rapid technical progress of the last 25 years he said:

"The answer lies, I believe, in the high development of a new tool of progress—the industrial research laboratory. Here is the place where the sciences meet. It is here that the whole great force of skill and knowledge in chemistry, physics, engineering and other sciences can be focused on a problem. We have come ahead rapidly and we have only begun."

The modern new research facilities the oil companies are installing today are our best guarantee of future Oil Progress Days.

A New Word is Born

WITH NO DESIRE to further or even condone the idea, the following is reprinted from a recent issue of *Chemical and Engineering News:*

"Through a typesetter's error one of our compatriots in the chemical publishing field has unwittingly contributed another item to the growing list being coined for chemical conversations. We refer to the word 'bydrocarbons' used in a description of the planned activities of the new Phillips Chemical Co. Since petrochemicals started essentially as by-products of the oil industry, perhaps by-product hydrocarbons, or bydrocarbons, wouldn't be such a bad name after all!"

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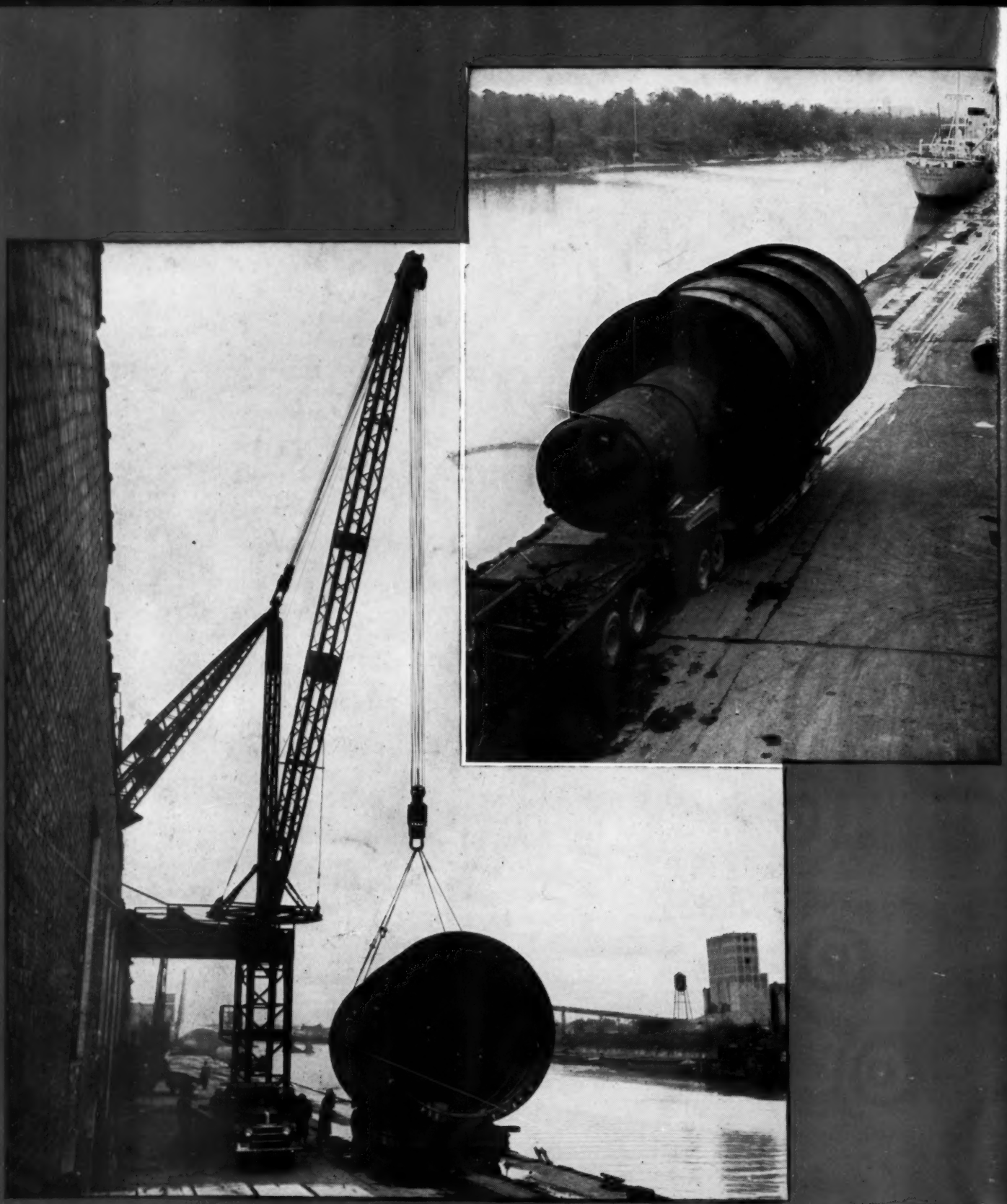

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